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NOTES ON PHILIPPINE TERMITES, III

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NINE PLATES AND EIGHT TEXT FIGURES

Coptotermes vastator sp. nov., described below, is by far the most destructive termite species of the Philippines; it is responsible for at least 90 per cent of the damage done by these insects and for all cases of major damage. There are some six species of *Coptotermes* in my collection of Philippine termites, but *Coptotermes vastator* is the only species that is at all common. It is one of the commonest termite species in the Islands and forms with *Macrotermes gilvus* (Hagen), *Neotermes malatensis* Oshima, *Microcerotermes* spp., and *Nasutitermes* spp. the conspicuous and commonly encountered elements of a much more extensive termite fauna.

As the distribution and collection records given below will show, I have this species in my Philippine collections from the islands of Luzon, Marinduque, Mindoro, Tablas, Samar, Negros, Cebu, Mindanao, Basilan, and Palawan. The species is also represented in collections from Manila and the following provinces in Luzon: Rizal, Bataan, Cavite, Laguna, Batangas, Tayabas, Bulacan, Pampanga, Pangasinan, Mountain, Ilocos Norte, and Cagayan. The wide distribution elsewhere and the incompleteness or entire lack of termite collections from the provinces and islands not represented in this list lead to the belief that the absence of records of its presence there is merely an index to the incompleteness of the collections in those localities rather than to breaks in the continuity of distribution of the species over the Archipelago.

A study of the collections according to the newer method (Light, 1927), which involves measurements of a large range of material and determination of proportional characters and ranges of variation, is under way. It seems necessary to avoid delay in naming so important a Philippine species, and hence this manuscript description of several years standing is published now preliminary to a more complete definition of the species.

COPTOTERMES VASTATOR sp. nov. Plates 1 to 6; text figs. 1 to 4.

Coptotermes travians OSHIMA, Annot. Zoöl. Jap. 8 (1914) 555; Philip. Journ. Sci. § D 12 (1917) 223; 17 (1920) 491.

Coptotermes formosanus OSHIMA, Philip. Journ. Sci. 17 (1920) 491.

DIAGNOSES

Adult.—Small, not over 12 millimeters long with the wings, head about 1.35 millimeters wide with the eyes, and 1.48 millimeters long to the tip of the labrum; head and abdominal terga dark brown, wings very light with only a faint brownish tinge, without costal stripe and with very little pigmentation at base of wing membranes; hairs of the wing membrane small, light, and evenly spaced except on either side of the medial and cubital veins and their branches where a clear space borders the single line of hairs marking the course of the veins; characteristically distinct, white, crescentic "antennal spots" at right angles to the long axis of the head and with the concave margin turned toward the clypeus; fontanel extremely minute, at the end of a tiny uplifted and projecting tube.

Soldier.—Head without mandibles about 1.4 millimeters long and 1.05 to 1.12 wide, not greatly flattened; fontanel about 0.15 millimeter in diameter, tubular but not greatly extended, making an angle of about 30° with the vertical; pronotum about 0.46 millimeter long and 0.8 millimeter wide; gula strongly contracted with a maximum width of about 0.35 to 0.40 millimeter and a maximum width of 0.23 millimeter; a single row of large spinelike hairs on each dorsal abdominal sclerite.

DESCRIPTIONS

Adult.—Plates 1 to 5, text figs. 1 and 2. Vertex and frons very dark brown, in some cases nearly black; postclypeus and labrum yellow, anteclypeus white, occiput, pronotum, and posterior region of mesonotum brown; pronotum lightest in the middle, anterior and posterior regions darker; posterior region of the metanotum lighter than the corresponding portion of the mesonotum; anterior regions of the mesonotum and metanotum

very light yellow; abdominal terga brown with an olive or smoky tinge; antennæ, palpi, legs, and underside of the head and body light yellowish brown; wings transparent with a faint brownish tinge, costal margins opaque, somewhat darker; margins and portions of the surface of the wing scales dark smoky brown.

Head not strongly pilose, with scattered, more or less symmetrically distributed spiny hairs and more numerous smaller hairs; pronotum and wing scales (dorsal surface) with numer-

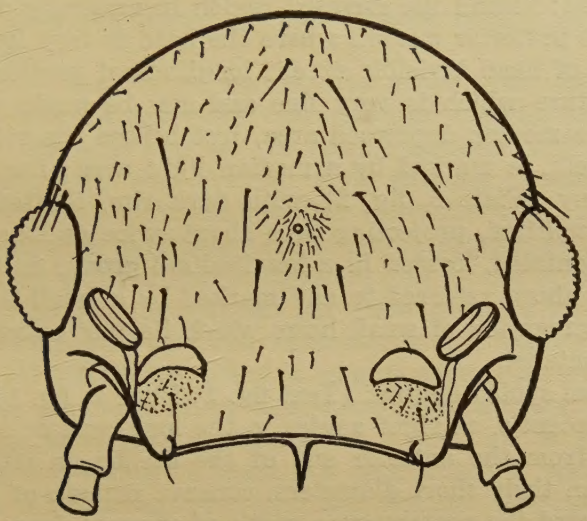

FIG. 1. *Coptotermes vastator* sp. nov., alate, head capsule in dorsal view, ca. × 60.

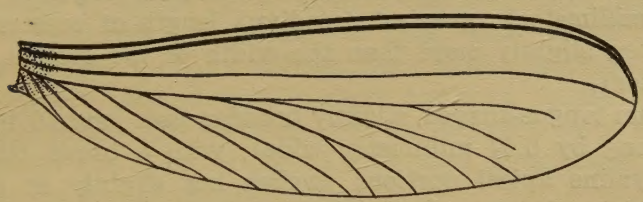

FIG. 2. *Coptotermes vastator* sp. nov., alate, sketch of forewing.

ous long spiny hairs; abdominal terga and sterna with a close-set growth of recumbent hairs and a more or less regular posterior row of erect hairs; pleural membranes of the abdomen of the female set with a thick coat of long rather slender hairs more or less clumped in certain areas, the same regions of the male nearly naked; wing membranes rather thickly and evenly set on both surfaces with short white hairs (Plate 2, figs. 4 and 5) about 0.58 millimeter long, separated from each other by a little more than the length of the hairs, distal half of posterior

margin of both wings with a close-set band of these hairs; costal margins and radial sector set with larger, darker hairs.

Head broad oval, sides slightly converging in front of eye, posterior to eye rounding broadly into the convex posterior margin, the whole margin behind the eye making a curve considerably flatter than a semicircle; surface of the head elevated between the eyes, particularly so in an arcuate ridge between the ocelli, convex posteriorly and again at the anterior margin of the frons; behind the elevated region increasingly depressed toward the posterior margin where the head is very low.

Sutures of head invisible except longitudinal portion of epicranial suture which is very fine and can be made out with difficulty; a median depressed area, just behind the ridge joining the ocelli, is marked by a median light area; fontanel extremely tiny (Plate 5, fig. 2) with dark rim, located at end of a tiny, uplifted, projecting tube about twice as long as diameter of fontanel, located in a longitudinal groove in the elevated ridge above referred to and marked by a small light spot and an aggregation of small hairs which lie just below and in front of fontanel.

"Antennal spots" distinct (Text fig. 1; Plate 2, fig. 1), white, thickly crescentic, at right angles to the long axis of head and separated from the anterior end of the ocellus on either side by less than their short diameters, concave margin of crescent turned toward the postclypeus; width of crescent from horn to horn about 0.15 millimeter, somewhat less than length of ocellus (0.177 millimeter); greatest (median) length of crescent 0.08 millimeter, slightly more than the width of the ocellus (0.075 millimeter).

Labrum tongue-shaped, slightly broader than long (0.43 millimeter long by 0.47 millimeter wide), with a broad but very short hyaline apical portion; swollen but slightly at center; posterior margin somewhat convex, anterolateral corners rounding broadly into the rounded anterior border.

Anteclypeus about as broad as long, longer than postclypeus, narrowed near the labrum which it somewhat overlaps.

Postclypeus trapezoidal, somewhat swollen, distinctly but not completely divided in the midline by a pigmented projection of the center of the frons, posterior margin convex, anterior margin concave; each half longest in its medial two-thirds and

decreasing in length to its very narrow lateral margin; length 0.14 millimeter, width 0.57 millimeter.

Mandibles as in Plate 4.

Gula considerably longer than wide with nearly straight anterior and posterior margins; lateral margins convex, converging strongly in anterior one-third, posterolateral corners rounded; length 0.58 millimeter, width 0.475 millimeter.

Eyes medium sized (that is, diameter between one-quarter and one-third the width of head without eyes); not strongly projecting.

Ocelli low, hyaline, elongated, oval, more than twice as long as wide; directed anteriorly and medially making an angle of 45° with the long axis of the head; posterior and outer end approaching very near the eye in its anterior one-third (Plate 2, fig. 1); length 0.177 millimeters, width 0.075.

Antennae of 20 to 22 segments (Plate 1; Plate 2, fig. 1), nearly twice as long as head (2.5 millimeters long where 21 segments); segment I largest, cylindrical, not quite twice as long as wide (0.2 millimeter long by 0.106 millimeter wide), slightly narrowed at center; II cylindrical, about as long as wide (0.84 millimeter); III usually smallest, often disk-shaped but varying in length; IV as long as III (22 segments) or longer; IV to VIII wider than long, increasing in length, IX approximately spherical; IX to XX or XXI increasingly long and elavate; terminal segment as long as preceding but narrowest, ovate.

Pronotum (Plate 2, fig. 3) slightly narrower than head with eyes; 1.2 millimeters wide and 0.84 long; with weakly concave anterior border, with or without very slight indications of a median notch; anterolateral corners rounded, lateral margins receding strongly and rounding into the biconvex posterior margin; median line faint, T-shaped area faint or invisible, a light spot near each anterolateral corner.

Forewing with scale 10.2 millimeters long, hindwing 9.5 to 10 millimeters long, maximum wing width 2.5 millimeters, costal margin and "radial sector" greatly thickened and conspicuous, other veins inconspicuous (Plate 3); radial sector, median, and cubitus about equally spaced at point of entry into forewing membrane (Plate 2, fig. 4); radial sector curves forward until near the costal margin and runs parallel to it and unbranched until it merges with it near the tip of the wing; the median,

curving somewhat posteriorly, runs near and parallel to the cubitus, separated by a wide space from the radial sector to which it is often united by one or two faint rudimentary branches, distally it is divided, width from two to four branches, the point of origin of the first branch varying widely from near the middle to near the tip of the wing; median of hindwing arises from radial sector near the base of wing membrane (Plate 2, fig. 5); veins of both wing membranes (median and cubitus and branches) scarcely visible, their course marked, however, by a single line of hairs separated by a distinct space from the surrounding hairs of the wing membrane; cubitus with from seven to nine main branches to the wing margin, from one to three of which are again divided, the number of main and secondary branches being in inverse ratio to the amount of division of the media; bases of media, cubitus, and the first two branches of the cubitus are thickened and pigmented and marked (as is a very narrow strip of the basal portion of the wing membrane) by tiny papillæ (Plate 2, fig. 5) suggesting those characterizing the wing ornamentation in the Kalotermitidæ; anal furrow white, very distinct in forewing (Plate 2, fig. 4), where it is slightly convex and runs into the posterior margin of the scale not far beyond its center, less distinct in the hindwing, where it is straight and ends at the suture; anal margin of scale with a small but distinct convexity proximal to the posterior end of the furrow (Plate 3); no "costal stripe" (Plate 2, fig. 5) below the radial sector such as characterizes many other species of this and other widely separated genera.

Cerci similar in male and female, with a thick basal joint and slender, elongated, incompletely segmented distal portion.

Sexual dimorphism.—Abdomen of male longer and slenderer than that of female; fifth sternite of female with slightly concave posterior border, sixth sternite of female terminal, greatly enlarged, much longer than other sternites but wider than long; posterior margin strongly convex but with a faint median notch; fourth sternite of male longest, fifth to eighth decreasing in size and proportionate length, fifth with straight or convex posterior margin, sixth with concave posterior margin.

Styles absent in female, in male arising from narrow white area at center of posterior margin of eighth abdominal sternum, slender, yellow, separated from one another by space nearly equal to their length.

Pleural membranes of abdomen of female closely set with a recumbent coat of long yellow hairs evidently connected with

trophallactic function, same membranes of male practically naked.

Measurements of alate of Coptotermes vastator sp. nov.

	mm.
Length, with wings	11.0–12.0
Length, with wings	6.0–7.0
Forewing, length	16.2
Forewing, width	2.5
Hindwing, length	10.0
Head, width with eyes	1.35
Head, width without eyes	1.18–1.22
Head, length	1.48
Head, length to clypeus	0.95–1.01
Pronotum, length	0.85
Pronotum, width	1.13–1.2
Antennæ, length	2.47
Segment I of antennæ, length	0.2
Segment I of antennæ, width	0.115
Segment II of antennæ, length and width	0.085
Hairs of wing membrane, length	0.055
Ocellus, length	0.17
Ocellus, width	0.075
Crescentic antennal spot, length from horn to horn	0.15
Crescentic antennal spot, maximum diameter	0.08
Labrum, length	0.43
Labrum, breadth	0.47
Postclypeus, maximum length	0.14
Postclypeus, maximum width	0.57
Gula, length	0.57
Gula, maximum width	0.475
Fontanel, diameter of aperture	0.01

Soldier.—Plate 6; text figs. 3 and 4. Head light yellow to yellow, mandibles red to reddish black, pronotum, antennæ, and hairs very pale yellow; other parts white to whitish yellow.

Head hairs very few and widely scattered, usually a girdle of six to eight large hairs around the head in front of its center; antennæ and palpi weakly haired (compared with other termites); labrum with two long, curved, slender hairs near tip; pronotum sparsely haired, a row of long, upright, widely spaced hairs around the margin, the two nearest the center of the anterior margin especially large; much smaller pronotum hairs scattered, most numerous on either side of the midline in the anterior portion; body not strongly haired; terga and sterna with smaller more or less recumbent hairs and a single row of longer, upright hairs near the posterior margin; distal half of tibiæ rather thickly set with short, distally-directed, spiny

hairs; tibial spines slightly bent, two on middle and hind tibiæ and three on foretibiæ.

Head elongated, ovate, varying considerably in shape and size among the soldiers of a given colony, between the soldiers of different colonies of a given region, and between races in different islands; sides parallel or faintly convex in the middle, converging strongly anteriorly from a point as far behind the antennæ as the mandibular articulation is in front of them; posterolateral corners rounding into the flatly convex posterior margin which is marked by a median slightly projecting region. Seen in profile (side view) the lower margin curves distinctly (text fig. 4) from the edge of the projecting region mentioned above to a maximum median ventral convexity near the middle of the head (measured from occiput to fontanel), then curves upward, but less strongly, to the mandibular articulation; the dorsal profile slopes gently upward from the very low occipital end for about one-third of its length, is flat in the median one-third with a faint median concavity, and slopes down in the anterior one-third to the upper rim of the fontanel; sides rounded; dorsal surface sloping toward the sides, particularly so from a point somewhat behind the antennæ where the head is drawn out to form the fontanel tube characteristic of the genus.

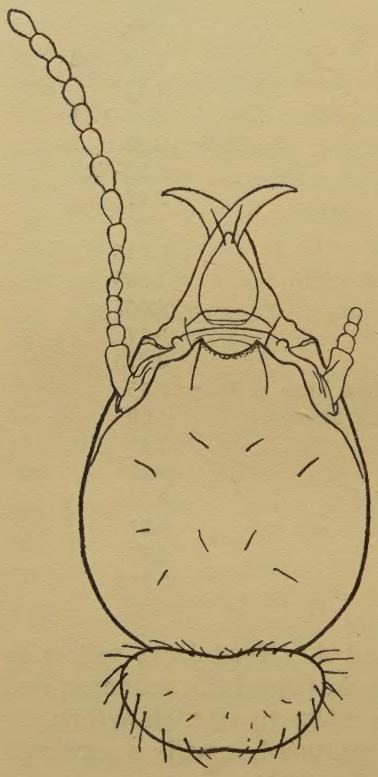

FIG. 3. *Coptotermes vastator* sp. nov., head of soldier from type colony, dorsal view.

Labrum tongue-shaped (Plate 6, fig. 3), reaching beyond the middle of the mandibles; sides convex in proximal one-half, converging very strongly in distal one-half where slightly concave; ending in a short, triangular, hyaline tip with two long,

slender, slightly curved hairs at its base; posterior margin somewhat convex, overlapping the clypeus above; posterior strip of labrum and anterior strip of clypeus (anteclypeus) hyaline; labral articulation on either side marked by distinct chitinous thickenings with incurved median ends; in median one-fifth no sign of separation between labrum and clypeus; labrum ornamented with what appear to be hairs with sunken bases (sensory hairs), which are particularly numerous in the distal region.

Clypeus trapezoidal, not clearly divided into anteclypeus and postclypeus; separation between frons and clypeus marked by a ridge forming the ventral rim of the fontanel aperture, marked at either end very near to the inner mandibular condyle by a single, long, spiny hair.

No eye rudiment visible even in cleared and dissected specimens.

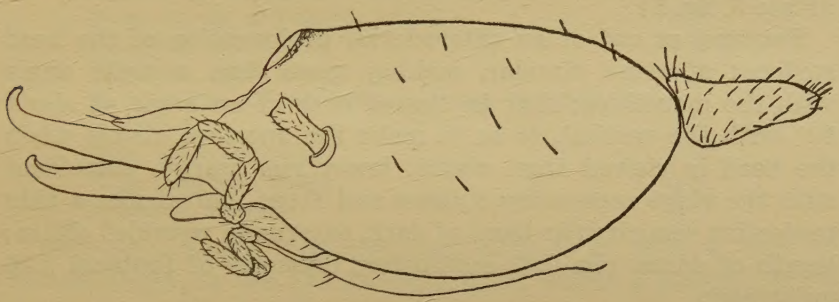

FIG. 4. *Coptotermes vastator* sp. nov., head of soldier, side view.

Antennæ about 1.5 millimeters long, with thirteen to sixteen, but usually fourteen or fifteen segments (Plate 6, figs. 1 and 3); I and II much as in adult; I cylindrical, about twice as long as broad (0.17 millimeter by 0.846 millimeter), somewhat swollen at the ends; II shorter and narrower (0.07 millimeter by 0.06 millimeter); III shortest and narrowest, obconic; where fourteen segments, IV about as long as III; where fifteen segments, III considerably shorter than IV, IV somewhat longer than broad, subspherical; V to VII increasing in length; VII to X about equal in length but increasingly clavate; XI to XIV decreasing in length; terminal segment about as long as next to last but narrower, ovate.

Mandibles (Plate 6) nearly straight in proximal two-thirds, bent inward increasingly toward the tips, which lie nearly at

right angles to the long axis; left mandible (Plate 6, fig. 2) slightly bent below the middle, making the outer margin of the basal half weakly convex; inner margin of left mandible smooth in distal half, basal half with a cutting edge bearing four crenulations increasing in size toward the base; internal surface of base of left mandible set off from above cutting plate by a notch and bearing a conspicuous chitinous plate, somewhat flattened above and directed distally and somewhat mediad, its tip reaching to the proximal margin of the basal crenulation; right mandible with smooth inner edge except near the base where it is somewhat roughened and marked, in some cases, by a low crenulation beyond which the blade slopes sharply to the much broader but untoothed mandible base; tips very sharply pointed; bases of mandibles with numerous tiny refractive spots connected with slender internal tubes (sunken hairs of a sensory nature).

Palpi long, maxillary palpi nearly as long as the mandibles (Plate 6, fig. 1).

Fontanel at end of an anterodorsal prolongation of the head surface; aperture circular, making more than a right angle with the mandibles; that is, tipped back at an angle of about 30° with the vertical, so as to make the aperture visible when the head is viewed from above; lower rim margin coincident with the ridge separating clypeus and frons, dorsal rim a thin projecting semicircular band of dark, externally wrinkled chitin; length of dorsal rim 0.02 millimeter; diameter of fontanel 0.15 millimeter.

Gula considerably narrowed behind, somewhat variable in proportions; 0.74 millimeter long from the anterior margin of occipital foramen to base of labium; maximum width 0.35, minimum width 0.22.

Pronotum with weakly biconvex anterior and posterior margins, anterolateral corners very broadly rounded to the middle of the lateral margins which recede rapidly from that point into the narrow posterior margin; anterior margin incompletely (dorsally) notched in the midline.

Cerci large, with a distal fingerlike portion about 0.1 millimeter long.

Styles lamp-chimney-shaped with plump basal portions contracted at point of origin and slender distal portions; about 0.09 millimeter long.

Measurements of soldier of Coptotermes vastator sp. nov.

	mm.
Length	5.0–6.0
Length without head	3.5–4.0
Head, length without mandibles	1.38–1.4
Head, length to fontanel	1.2
Head, width	1.045–1.13
Pronotum, length	0.46
Pronotum, width	0.8
Antenna, length	1.5
Segment I of antennæ, length	0.17
Segment I of antennæ, width	0.084
Segment II of antennæ, length	0.07
Segment II of antennæ, width	0.06
Labrum, length	0.388
Labrum, maximum width	0.30
Labrum, width at base	0.23
Hyaline tip of labrum, length	0.05
Hyaline tip of labrum, width at base	0.075
Hairs at tip of labrum, length	0.15
Mandible, left, length	0.82
Mandible, right, length	0.76
Gula, length (from anterior margin of cervical foramen)	0.74
Gula, maximum width	0.35
Gula, minimum width	0.23
Fontanel, diameter	0.15

Worker.—Small, inconspicuous, whitish or with a pale yellowish tinge; in life the abdomen often shows a pinkish or salmon tinge due to the intestinal contents seen through the transparent body wall.

Head, body, and appendages covered with a fairly close coat of small white or faintly yellowish hairs with a few longer more conspicuous hairs in a single row near the posterior margin of each sternum and tergum.

Sides of head in anterior half parallel or faintly convex, curving from about middle into curved posterior margin and making with it a semicircle; anterolateral corners nearly square; mandibular articulations considerably mediad leaving a nearly straight anterior surface on either side; head low, depressed in region of frons, clypeus swollen; sides of head rounded. Fontanel inconspicuous. No eye rudiments.

Labrum pentagonal, about as long as broad, swollen but little, with a short, broad, hyaline apical strip; surface ornamented with corrugations and rows of spots.

Antenna of fifteen segments, nearly as long as in soldier.

Pronotum shaped much as in soldier but with more strongly biconvex anterior margin.

Measurements of worker of Coptotermes vastator sp. nov.

	mm.
Length	4–5
Head, width	1.12
Head, length	1.33
Head, length to mandibular articulation	1.013
Antenna, length	1.48
Pronotum, length	0.38
Pronotum, width	0.68

Systematic position.—The species of *Coptotermes* in general and those of the Oriental Region in particular fall into distinct groups on the basis of the size and shape of the head of the

FIG. 5. *Coptotermes formosanus* Shiraki, from Honolulu, forewing. Note that it is larger than the forewing of *C. vastator* (see fig. 2 drawn to the same scale) and has more pigment at the base and in the form of a "costal stripe."

soldier. The two most definite groups I shall designate as the *travians* group and the *curvignathus* group. The former includes the forms in which the head is considerably elongated, is produced to form a fontanel tube, and is high in front, and in which the fontanel has an angle of inclination of less than 45°. Here fall the greater number of the Oriental species including *C. vastator* sp. nov. The species of the *curvignathus* group have soldiers with broad flat heads and large fontanels with a great angle of inclination.

The *travians* group itself falls into three more or less artificial groups of species based on the size of the head of the soldier. One consists of several very small undescribed Philippine species whose head width is less than 1 millimeter. A second, and intermediate group, consists of species with a head width in the soldier of from 1 millimeter to 1.25 millimeters and includes *C. bornensis, C. ceylonicus, C. formosanus, C. gestroi, C. heimi,*

Complete collection records of Coptotermes vastator sp. nov.

Collection.	No.	Collector.	First reported.	Island.	Province.	Locality.	Remarks.
Taihoku		R. C. McGregor	Oshima, 1920	Luzon		Manila	*C. formosanus* of Oshima.
Do		do	do	Panay	Antique	Culasi	*C. travians* of Oshima.
Author's	1	Light	This paper	Luzon		Manila	
Do	2	do	do	do		do	
Do	11	Miss Florentina Hernandez	do	do		do	
Do	13	do	do	do		do	
Do	29	Miss Ursula B. Uichanco	do	do		do	Attacking Philippine Normal School building.
Do	35	McGregor and Light	do	do	Rizal		
Do	54	Miss Hernandez	do	do		Manila	
Do	55	McGregor	do	do		do	Alates in nest, June 13.
Do	56	W. A. Wiedemann	do	do		do	Attacking books in Escolta store.
Do	64	McGregor and Light	do	do	Rizal		
Do	70	Miss Hernandez	do	do		Manila	
Do	76	Light	do	do		do	
Do	86	McGregor and Light	do	do	Rizal		
Do	87	Light	do	do		Manila	Attacking San Andres School building.
Do	88	do	do	do		do	Attacking storeroom supplies of University of the Philippines Hall.
Do	92	McGregor and Light	do	do	Bulacan		
Do	93	do	do	do		Manila	
Do	125	do	do	do		do	Attacking telephone poles.
Do	126	do	do	do		do	Do.
Do	129	Miss Uichanco	do	do			
Do	130	do	do	do		do	Attacking Philippine Normal School building.
Do	131	do	do	do		do	Do.

Complete collection records of Coptotermes vastator sp. nov.—Continued.

Collection.	No.	Collector.	First reported.	Island.	Province.	Locality.	Remarks.
Author's	133	Miss Uichanco	This paper	Luzon		Manila	Attacking Philippine Normal School building
Do.	145	Miss Hernandez	do.	do.		do.	Do.
Do.	171	Prof. L. D. Wharton	do.	Cebu	Cebu	Cebu	Attacking Smith-Bell bodega.
Do.	195	McGregor	do.	Luzon	Rizal	Pasay	
Do.	200	Miss Hernandez	do.	do.		Manila	
Do.	213	Light	do.	do.		do.	Attacking Freer Chemical Laboratory building. Came in over gas pipe.
Do.	244	McGregor and Light	do.	do.	Rizal	Balintauac	
Do.	247	E. Lucas	do.	do.	do.	Pasig	
Do.	259	G. Gonzales	do.	do.	Tarlac	Concepcion	
Do.	265	do.	do.	do.	do.	do.	Workers show fungus disease!
Do.	275	Mr. Lopez	do.	do.			Queen present.
Do.	276	Miss Paz Teopaco	do.	do.	Pampanga	San Fernando	
Do.	325	Dr. J. Andaya	do.	do.		Manila	Attacking wood work of Student Y. M. C. A. building.
Do.	334	McGregor and Light	do.	do.	Batangas	Tanauan	
Do.	336	do.	do.	do.	do.	Batangas	
Do.	355	do.	do.	do.	Cavite		
Do.	358	do.	do.	do.	Laguna	Santo Tomas	
Do.	405	Daniel Riola	do.	do.	Tayabas	Tayabas	
Do.	406	do.	do.	do.	do.	do.	
Do.	415	McGregor and Light	do.	do.	Rizal	Balintauac	
Do.	420	do.	do.	do.	Laguna	Los Baños	
Do.	429	Light	do.	do.		Manila	
Do.	430	do.	do.	do.		do.	

Do.	438	McGregor	do.	do.		do.	
Do.	449	do.	do.	do.		do.	
Do.	454	Light	do.	do.		do.	
Do.	457	do.	do.	do.		do.	
Do.	458	do.	do.	do.		do.	
Do.	461	do.	do.	do.	Rizal	Pasay	Alates in nest, May 5.
Do.	465	do.	do.	do.		Manila	Adults flying, evening of May 3, 1921.
Do.	467	McGregor and Light	do.	do.	Rizal	Balintauac	
Do.	471	Dr. Hilario Roxas	do.	do.		Manila	Alates flying, evening of May 10, 1921.
Do.	472	Light	do.	do.	Rizal	Pasay	
Do.	473	do.	do.	do.	do.	do.	
Do.	479	do.	do.	do.	Pangasinan	Rosales	
Do.	486	Mr. Tansinsin	do.	do.	Bulacan	Bulacan	
Do.	487	do.	do.	do.	do.	do.	
Do.	488	do.	do.	do.	do.	do.	
Do.	491	McGregor	do.	do.		Manila	
Do.	492	Light	do.	do.		do.	Great swarm in my house, May 24, 1921, as described in this paper.
Do.	494	McGregor	do.	do.		do.	Attacking documents in the Bureau of Science building.
Do.	498	do.	do.	do.		do.	
Do.	504	Light	do.	Cebu	Cebu	Cebu	Alates, April 20, 1921.
Do.	529	Mr. Gonzales	do.	do.	do.	do.	
Do.	535	Light	do.	do.	do.	do.	Alates flying, May 2, 1921.
Do.	536	do.	do.	do.	do.	do.	Do.
Do.	538	do.	do.	do.	do.	do.	Do.
Do.	586	Dr. J. W. Chapman and Light	do.	Negros	Oriental Negros	Above Luzuriaga	
Do.	588	do.	do.	do.	do.	do.	Alates, May 11, 1921.
Do.	589	do.	do.	do.	do.	Dumaguete	

Complete collection records of Coptotermes vastator sp. nov.—Continued.

Collection.	No.	Collector.	First reported.	Island.	Province.	Locality.	Remarks.
Author's	593	Dr. J. W. Chapman and Light	This paper	Negros	Oriental Negros	Dumaguete	Entering beams well coated with creosote.
Do	594	do	do	do	do	do	Alates flying, May 12, 1921.
Do	598	do	do	do	do	Polo Plantation	Destroying "palma brava" floor.
Do	597	do	do	do	do	Above Luzuriaga	Alates flying.
Do	625	Mr. P. Cartagena	do	Panay	Iloilo	Oton	Eating clothing in trunk.
Do	638	McGregor and Light	do	Luzon	Bataan	Mount Mariveles	
Do	646	do	do	do	do	do	
Do	704	Light	do	do		Manila	
Do	711	Mr. Primitivo Sustento	do	Panay	Iloilo	Santa Barbara	
Do	737	Mr. Ramon Nicdao	do	Luzon	Pampanga	San Fernando	
Do	738	do	do	do	do	do	
Do	739	do	do	do	do	do	
Do	764	Mr. Felino Fernando	do	do	Bulacan	Malolos	
Do	782	Miss Teopaco	do	do	Pampanga	San Fernando	
Do	783	do	do	do	do	do	
Do	784	McGregor	do	do		Manila	Alates flying.
Do	785	do	do	do		do	Alates flying, May 6, 1921.
Do	790	Miss Bernardo	do	do	Bulacan	Malolos	
Do	795	Miss Hernandez	do	do		Manila	
Do	818	Light	do	do		do	University Hall, University of the Philippines.
Do	822	Garcia and Light	do	do	Manila	do	Attacking flooring, second floor, Bureau of Printing building.
Do	824	do	do	do		do	Attacking cattle sheds, Pandacan Quarantine Station.
Do	825	Light	do	do		do	Attacking living papaya tree through roots.
Do	826	Gregorio Lopez	do	do		do	

Do	835	McGregor	do	do		do	Attacking Bureau of Science building.
Do	836	do	do	do		do	Alates in nest, April 21, 1921, Bureau of Science building.
Do	837	do	do	do		do	Alates flying, April 21, 1921.
Do	853	Light	do	do		do	Alates flying, April 12, 1921.
Do	855	do	do	do		do	
Do	857	Ramos	do	do	Mountain	Moncayan	Workers attacked by fungus.
Do	858	do	do	do		do	Do.
Do	868	do	do	do		do	From open pine forest.
Do	869	do	do	do		do	
Do	870	Mr. Sabino Garduque	do	do	Cagayan	Claveria	Attacking books in house.
Do	878	Light	do	do		Manila	Attacking "jarra wood" posts, Bureau of Forestry building.
Do	882	do	do	do		do	Attacking lauan, pine, redwood, and ipil in house.
Do	876	Dr. F. X. Williams	do	do	Laguna	Los Baños	Attacking house.
Do	904	Mr. Jose Coligado	do	do		Lilio	
Do	905	do	do	do		do	
Do	906	do	do	do		do	
Do	917	Mr. R. Flores	do	do	Pangasinan		
Do	925	Light	do	do		Manila	Alates flying, February 28, 1922.
Do	926	do	do	do		do	Alates flying, April 22, 1922.
Do	947	McGregor	do	do		do	Alates flying, February 16, 1922
Do	948	Light	do	do		do	Alates flying, February 20, 1922.
Do	951	do	do	do		do	Alates flying, April, 1922.
Do	970	McGregor	do	do	Pangasinan	Alaminos	
Do	973	Taylor	do	Tablas	Romblon	Odiongon	
Do	978	do	do	Marinduque	Tayabas	Boac	
Do	985	do	do	Tablas	Romblon	Odiongon	
Do	1002	McGregor	do	Luzon	Pampanga	Mount Arayat	
Do	1010	do	do	do		Manila	Alates flying, April 23, 1923.
Do	1137	Taylor	do	Mindanao	Cotabato	Milbuk	
Do	1170	do	do	do	do	Luan River	

Complete collection records of Coptotermes vastator sp. nov.—Continued.

Collection.	No.	Collector.	First reported.	Island.	Province.	Locality.	Remarks.
Do	1180	Taylor	This paper	Mindanao	Cotabato		
Do	1191	do	do	do	do		
Do	1210	do	do	Palawan	Palawan	Puerto Princesa	Tatayan Island.
Do	1220	do	do	Mindoro	Mindoro	Mangarin	
Do	1229	do	do	Palawan	Palawan	Puerto Princesa	
Do	1232	do	do	do	do	do	
Do	1253	do	do	do	do	Sir J. Brooke Point	
Do	1257	do	do	do	do	do	
Do	1266	McGregor	do	Luzon	Ilocos Norte	Bangui	
Do	1267	do	do	do	do	Piddig	
Do	1320	do	do	do	do		
Taihoku	[a] 1323	do	do	do		Manila	*C. formosanus* Oshima, 1920.
Author's	1331	do	do	do		do	
Do	1336	do	do	Samar	Samar	Loquilocon	
Do	1337	do	do	do	do	do	
Do	1338	do	do	do	do	do	
Do	1421	F. X. Williams	do	Luzon	Laguna	Los Baños	Alates flying, May 26, 1924.

[a] My collection.

C. parvulus (possibly belongs in first group), and *C. travians.* To this difficult group *C. vastator* belongs. The third group, in which the soldier's head is considerably larger, includes in the Oriental Region as yet only *C. dobonicus.* As the descriptions of the species concerned stand at present it is impossible to determine with satisfaction the different species of the group to which *C. vastator* belongs on the basis of soldier characters. Pending the much-needed revision of this group, which I hope to make, it becomes necessary for reasons given below to consider the common Philippine species a new species, *Coptotermes vastator.*

Of the *travians* group, *C. travians* and *C. bornensis* seem separated by no definite character, and they may be considered as extremely closely related if not the same species. *Coptotermes parvulus,* while approaching *C. travians* in size, because of its relatively shorter head and its geographical separation, is probably distinct from the others. *Coptotermes formosanus* is readily separated because it is generally larger with considerably longer and usually broader head. This leaves five species (namely, *C. travians, C. heimi, C. ceylonicus, C. gestroi,* and *C. vastator*), which on the basis of soldier characters as embodied in the systematic descriptions available seem very closely related. *Coptotermes gestroi,* which is sadly in need of redescription, seems separable on the basis of its smaller and particularly narrower pronotum; according to Holmgren the sides of the head are much more rounded. The geographical distance allows us to eliminate *C. ceylonicus* and *C. heimi,* although the presence of a single row of enlarged abdominal hairs on each tergum would differentiate *C. vastator* from these species, which according to Holmgren have two, as well as from *C. travians* which according to Holmgren has none. The much shorter pronotum length given by Holmgren would also tend to separate *C. travians* from *C. vastator.*

The characters of the adults are unknown for *C. bornensis, C. parvulus,* and *C. gestroi.* From *C. travians* the new species seems clearly differentiated by having twenty to twenty-two antennal segments and greater head and pronotum size. The smaller size of *C. vastator* clearly differentiates it from *C. formosanus, C. robustus, C. ceylonicus,* and *C. menadoensis* Oshima. With *C. heimi* and *C. havilandi* the new species seems to form a group of medium-sized termites. The pronotum seems longer in *C. vastator* (0.85 millimeter as compared with 0.72 millimeter and 0.76 millimeter in *C. heimi* and *C. havilandi,* respec-

tively). Other apparent differences from *C. heimi* Wasmann are that antennal segment IX in *C. vastator* is approximately spherical, that the pronotum is not distinctly notched in the anterior margin, and that the median is branched distally. Other apparent differences from *C. havilandi* Holmgren are that the size is considerably less (11 to 12 millimeters in *C. vastator* and 12 to 13.5 millimeters in *C. havilandi*), the abdomen is smoky brown not reddish, the head is considerably smaller, and the pronotum is considerably narrower and longer.

It seems worth while to give the complete collection records of this, the most-important Philippine species. I take this opportunity to thank the many persons named in the records who helped to accumulate this splendid collection. Many of them were members of my classes in the University of the Philippines.

BIOLOGY

It will be seen that collections from approximately one hundred fifty colonies of *C. vastator* are available for study, far more material than is available for any other species of the genus. These include about twenty-five collections of alates of which about twenty were made at time of swarming and hence consist of alates alone. Five collections containing alates were made from the colony and include workers, soldiers, and alates. In only one is the queen present (No. 265). This scarcity of royal individuals is due to the subterranean location of the nest of the species of this genus.

This extensive material is being used in a careful, much-needed study of the variation within a single species of termites. Such a study should be complemented by studies of variation among the thousands of individuals of a single colony at a given time and variation within the same colony at intervals over an extended period. Such studies will be of the greatest systematic value as well as of theoretical significance.

The data at hand show that the swarming period for alates begins as early as the middle of February and extends to the end of May. That less numerous emergences occur into June seems certain. That the definitive swarming takes place during the period of the preliminary showers of the opening rainy season seems also certain.

I am told by Filipino friends that there exists a local "superstition" that a flight of termites will be followed by a heavy rain. This is no superstition, however, but a record of observed fact. That such swarmings occur under conditions of baro-

metric pressure, temperature, and humidity such as precede, coincide with, or follow the first heavy rains of a wet season is an observation which I have made for this and other termite genera in the Philippines, China (Fukien Province), and California, and which has been recorded by numerous students of termites the world over. The same observation made by many Filipinos in times past has given rise to the so-called superstition.

It is interesting to note further, as instancing rather unusually keen observation and correlation, the common knowledge among Filipinos that the many diverse types of termites (soldier and worker castes of many genera) are related. The common name "anay" is unhesitatingly applied to them all with the single exception of the type that is found in isolated boards in houses, as *Cryptotermes cynocephalus* Light and *Planocryptotermes nocens* Light, which are called "gorgojo" or "buc buc" and confused with boring-beetle larvæ which they strongly suggest. Here, as is generally true elsewhere, however, the winged termite is not connected with the other castes, from which it differs markedly, but is given the name (so I am told by my Filipino pupils) of "gumgum" in Tagalog and "alibusbus" (Leyte) and "obus" (Cebu) in Visayan.

It seems worth while in this connection to include my journal accounts of a remarkable swarming of *C. vastator* that occurred in the house in which I was living on Gral. Luna Street, Manila.

Date of swarming: May 24, 1921, 6 to 7.30 p. m.

Weather conditions: Cloudy, close, very slight showers, thunder in the distance, heavy showers later during the night.

Swarming took place successively from various parts of the house. Dirt galleries, not present or at least not conspicuous previously, had been built out at several points along door posts etc. From projecting portions of these as well as from cracks between nearby boards the winged adults were boiling out when first observed. Guarding these openings were numerous soldiers making a solid line with heads facing out. These seemed to have nothing to do with the actual emergence of the adults but to be a guard to prevent entry of that terrible enemy of the termite, the true ant. Many of these as well as a few workers were carried out by violence of the emerging alates. This theory of the function of the soldiers at these openings seems weakened by the observation that one of these openings was still unclosed thirty minutes after completion of the flight, and no soldiers were in sight. This observation was made at one point only, however, and is not conclusive.

In one room where the floor was badly attacked the alates swarmed through the cracks in immense numbers and formed a struggling mass about 3 feet in diameter and 2 inches deep. The sound made by the wings of the thousands of emerging, struggling, and flying individuals was very suggestive of the soft yet pervasive sound of a first heavy snow.

The emerging alates, demonstrating remarkably strong positive phototropism, flew at once toward the nearest or strongest source of light. They were lead throughout the house by turning lights on and off in series. When two lights of the same magnitude were on in adjoining rooms the lower members of the swarms were not directly under either light but each swarm bent outward toward the bottom in the direction of the other light, their positions being a resultant of the attraction of the two lights. This could be clearly demonstrated by doubling the lights at one point when this living curve moved toward the stronger light until a new equilibrium was attained considerably nearer the brighter light.

They were strong and rapid flyers. A great cloud of thousands about the light near an open door would sweep out of the door in a few moments were the light turned off. Especially rapid was this movement when an outdoor light was switched on and the inner light was switched off. What became of them after they left the house I could not determine. That they fell prey in very great part to ants, lizards, bats, rats, etc., seems certain as I have observed to be the case on many occasions and as have many other observers in many regions. But few of them at first reached the lights of the next house a scant 50 feet away. Later they appeared there in large numbers, whether from the house itself or from our swarm was not determined.

The emergence at any particular point seemed to last not longer than twenty minutes, but termites were emerging at some point for the better part of an hour, and a few congregated about any lights for an hour after that. Similar swarms occurred at many points of the city and no doubt over a much wider area corresponding to similar conidtions.

I saw but little evidence of mating. Of courting movements of the female such as described by Fuller (1915), I saw nothing. Wings were lost by many individuals but apparently more from accident than in the normal course of events. Numerous individuals had hidden themselves under books on a woven bam-

boo center table where many had lost their wings, and a few exhibited the mating movements, the male following immediately behind the female with his head touching the tip of the female's abdomen and his antennæ continually playing on its dorsal surface. One such pair when placed on moist earth in a tin continued these movements. They ran round and round the rim of the tin and under the edges of the larger pieces of earth as if investigating.

Numerous specimens were caught in open tin boxes moved back and forth through the swarms under light. These boxes were left tightly closed and when opened in the morning to my surprise all the termites were found very active and still winged. No sign of mating was noted. In the other box there was some moisture and many individuals had lost their wings, whether normally or by getting them caught in the moisture I do not know, but probably the latter. No sign of mating here either.

At about 10 a. m. the contents of the first box were emptied into a large aquarium jar in which had been placed moist earth and a piece of packing pasteboard. No signs of mating were noted for some time and no shedding of wings. Later one pair was seen in mating attitude and one or two shed their wings. Apparently either the proper stimulus for wing shedding was lacking or the period of normal reaction had passed. As to mating, it seems probable that the close intermingling of the sexes for so long a time had pretty well distributed the scent.

Numerous test tubes were fitted up according to the method of Oshima (1919) and a male and a female placed in each. Digging operations were undertaken at once in spite of wings. Food (cotton, filter paper, fine shavings, and excelsior) seemed to confuse them and retard operations. When observed at 2, 3, and 5 p. m. they were mostly on the surface due, probably, to the retarding presence of wings. One pair had shed the wings. One pair had made a hole large enough to hold the female, but she had become fast by her wings. These I cut off 1 to 2 millimeters behind the wing stumps. On being returned to the test tube they began work more energetically than ever, the female going into the hole and the male behind her pushed and nipped at the end of her abdomen relentlessly forcing her on for a time. Later he widened the upper part of the cavity, but soon returned to his former tactics which forced the female on to greater effort and prevented her returning if she would. This excavation, except at first, is not by actual removal of dirt particles but by pushing them aside and manip-

ulating them first with the mouth parts and afterward with the feet. The male, by dint of strenuous efforts, turned around, thus making the upper part of the cavity quite wide, and emerging ran over to the piece of cotton at one side, but soon returned to the cavity.

Later, about 1.30, the specimens from the other box were placed in the jar. Here the wingless individuals as well as a wingless female and a winged male began mating. I failed to note mating on the part of two winged individuals or of winged female and wingless male. It would seem that dealation, even though abnormally accomplished, allows for mating and that dealation of the female is accompanied by some change necessary to stimulate the male to mating which may take place although the latter is still winged.

Many couples dug themselves in, but for some reason they were unable to succeed in establishing themselves, perhaps because of lack of food. Many of the couples which set up their abode in the cells of the packing board soon began to eat and to close their cells with chewed particles of the pasteboard. The observation, that the pair forage for themselves, agrees with that of Oshima (1919) as against the common opinion that the royal pair subsist and feed the first brood of wokers on food stored within their bodies.

Many of the females laid one or more eggs, but the experiment was soon stopped because of lack of time and the attack of fungus.

ECONOMIC IMPORTANCE

It may safely be said that if all termite species except *C. vastator* disappeared from the Philippines the major economic problem would be little changed. This species is common throughout the Islands. The soldier in this genus has as a special characteristic, a greatly developed cephalic gland and, on attack, a milky white acid secretion is thrown out in a copious drop through the large anteriorly directed circular fontanel which lies at the end of a frontal tube just above the base of the mandibles (text fig. 4). This not only furnishes an effective protection against their arch enemies, the true ants, but it has been maintained that the acid secretion is used in dissolving the lime in mortar thus giving access to the wooden portions of buildings otherwise unapproachable. Furthermore, the colonies are large with great numbers of permanent workers. Their nests are well protected, usually in the ground, but sometimes within the timber attacked. They exhibit the greatest ability and persistence

in reaching the wooden structures of buildings taking advantage of any crack or faults in cement or cracks in resistant or treated timbers, or eating a way through timbers ordinarily immune to reach more-favored food supplies, and always and most persistently building over and around obstacles to reach softer woods of the superstructure. Numerous instances of this ability might be cited. In the detention shed of the cattle quarantine station of the Bureau of Agriculture of the Philipine Islands, located in the outlying district of Pandacan, Manila, we have a very fine example of what this termite will do to obtain wood supply. The sheds have a concrete foundation and concrete pillars. Through the center run two cement mangers. Bolted to the tops of the mangers are some twenty-six supporting posts of jacal bolted above to timbers of apitong supporting the roof (Plate 8, fig. 1). The roof timbers of all the sheds were badly attacked and in many cases immediate replacement was necessary. Estimates by the Bureau of Public Works set the cost of repair at 100,000 or more pesos. In many of the sheds no ground connection is noticeable. The covered galleries appearing here and there on the roof timbers, however, are significantly composed of the usual mixture of earth and fæcal wood waste (Plate 8, fig. 1; Plate 9, fig. 1). A careful search in several of the sheds showed the method of approach. Faults in the concrete, some of them exposed and some of them internal, allowed the termites to pass the concrete foundation (Plate 9, fig. 3). Once through this they built their covered ways, when necessary, over the concrete to the bases of the yacal posts. Now yacal is a termite resistant wood, but by taking advantage of cracks or where cracks were lacking, by eating a passageway they reached the softer, susceptible apitong, which they completely riddled (Plate 9, fig. 2).

In several large concrete buildings in Manila, such as those of the Philippine Normal School and the Student Young Men's Christian Association this species of termite is to be found destroying the woodwork on the upper floors. In these buildings the concrete lower floor rests on the ground, and the termites enter through cracks. Wherever the floor is raised above the ground the entry of the termites is difficult, yet even under those conditions they build their covered passageways up the walls and take advantage of any opening to enter the building, particularly from the inside, for darkness and dampness are to their advantage. In the Freer Laboratory of the University of the Philippines where the construction is of this type and

there are apparently no cracks, *Coptotermes* entered between a gas pipe and the casing pipe and eating their way through an ipil plank were beginning the destruction of the softer white lauan desks. Filling the aperture with paint was sufficient to stop this attack, those already within the building soon succumbed when shut off from below. I am indebted to Mr. Sylvester, constructing engineer of the Bureau of Public Works, Manila, for another example of the quickness of *Coptotermes* to take advantage of any opening. The Municipal Building of Tayabas was found to be very seriously attacked; the roof was so badly damaged as to require extensive repair. An investigation of this building showed that the concrete columns had been left open above to the roof and that the wooden frame around which the columns had been constructed had been left within the columns, as is usual, thus furnishing a most satisfactory stairway whereby the termites might reach the roof timbers.

In common with all other true subterranean termites, that is all seriously harmful termites, *Coptotermes* has one vulnerable point. This is the necessity of maintaining a ground connection, not only because the central nest with the royal pair and young is usually there, but also because moisture is necessary to continued existence. It may be also that the soil which they freely use mixed with excreta in making their covered passageways is in some other way necessary to the successful development of the colony. Whatever the causes may be, it seems certain that in most, if not all, cases a shutting off of the ground connection results in the death of those in the building and prevents further destruction. Here, then, is the crux of the termite problem. How, in case of buildings already attacked, to isolate the superstructure from the ground and to build in such a manner as to prevent entrance from the ground or the reaching of the ground by colonies which may arise in the building from chance entrance of winged pairs if, as is claimed by Oshima, such an origin is possible.

While I am convinced that a thorough study of such cases would demonstrate a ground connection, it must be noted that instances have been reported of flourishing colonies doing considerable damage where no ground connection could be demonstrated. Certainly those of *Coptotermes formosanus* established in ships have no such connection. If we keep in mind their almost uncanny ability to penetrate considerable thicknesses of concrete by taking advantage of all cracks and faults, and,

keeping out of sight, to attack the upper floors of large buildings and to damage the wooden structures, I believe we are justified, in the absence of convincing proof to the contrary, in acting upon the belief that a ground connection is necessary and in so treating attacked buildings and in so constructing new buildings that the possibility of such ground connection is minimized or eliminated.

No doubt faultless concrete construction of the proper type, as described by Oshima (1919) and Woodeson (1921), would

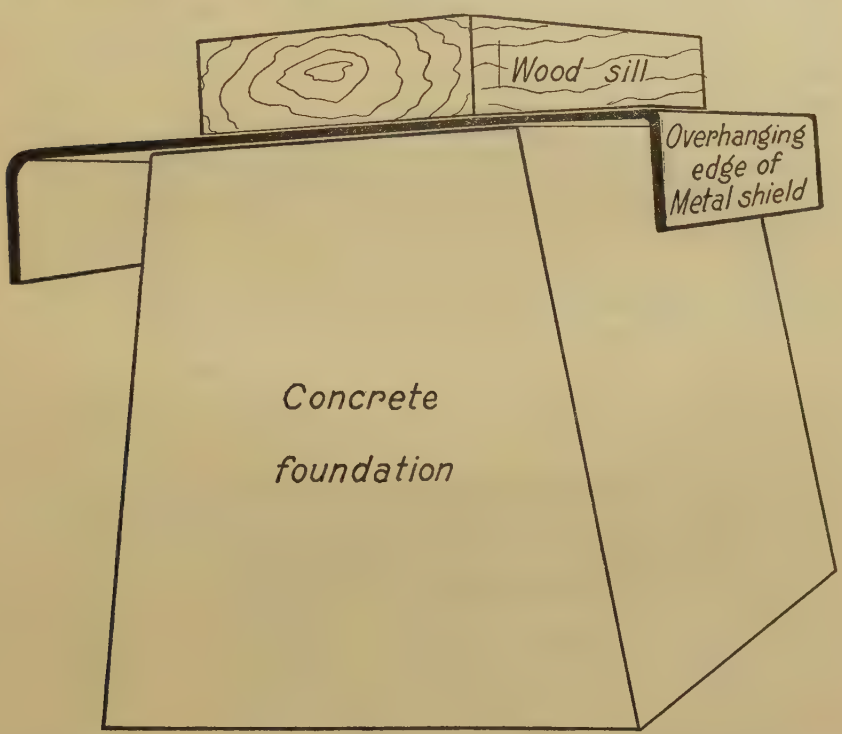

FIG. 6. The termite shield in crude practical form for small houses as in use in certain parts of California. Kindness of California-Hawaiian Sugar Refinery, Crockett, California.

eliminate a considerable amount of termite damage; but conditions in the Tropics are not conducive to such construction, and a single fault may give entry to the entire building and be extremely difficult if not impossible to find and to remedy. It would seem necessary, therefore, to have recourse to some more certain method of isolating the superstructure.

To fill this need I have devised what I have called the "termite shield." This consists in its most radical form of a continuous metal layer through house post or foundation wall continued

externally as a hanging edge (text figs. 6 to 8). Where it is necessary to have a firm bond between posts and superstructure, as in regions subject to earthquakes it might be necessary to

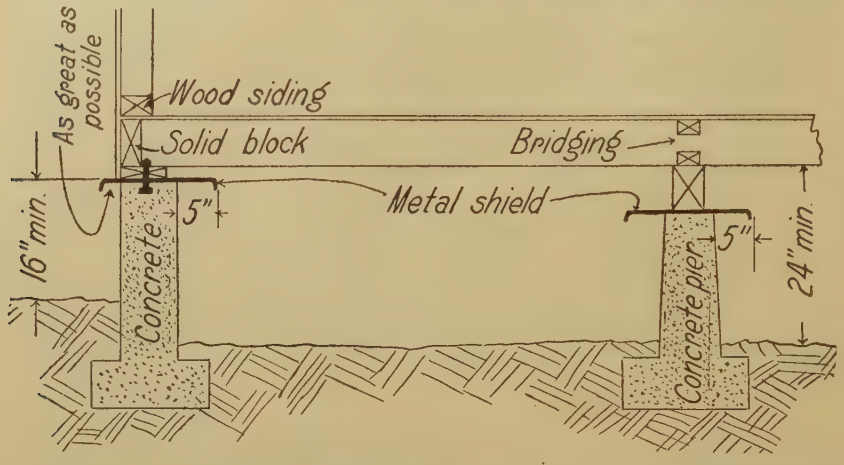

FIG. 7. Plans for protection of buildings against subterranean termites. Modified silghtly from plans issued by Mr. Walter Putnam, city superintendent of buildings, Pasadena, California. Used by permission of Mr. Putnam.

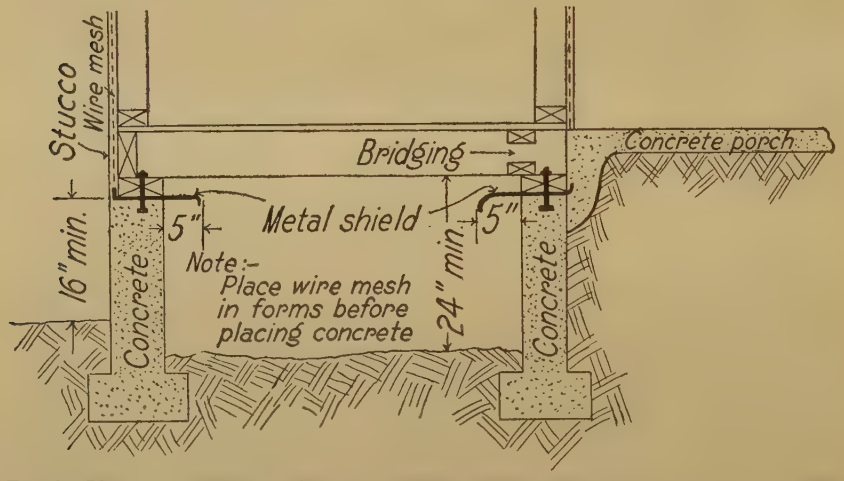

FIG. 8. Plans for protection of stucco building against subterranean termites. Modified from plans issued by Mr. Walter Putnam, city superintendent of buildings, Pasadena, California. The chief modification is in ending the stucco at the upper level of the concrete foundation. The color scheme may be preserved by a wash on the foundation surface to correspond with the stucco.

construct the shield of cast iron or steel with a double spur-box to allow of the bolting below and above. The objections to this are the cost and the danger of rusting out. Bolting through galvanized iron proves satisfactory (text figs. 8 and 9) if the

hole is soldered. Where earthquakes are not common a device similar to that in use in Australia and South Africa consisting of a heavy galvanized iron cap for house posts will be effective (text figs. 6 to 8). In such cases if the pillar is of cement and the cap in the shape of an inverted cup it should be cheap, effective, and lasting. If the post is of wood even though both of the resistant type and thoroughly termite proofed, the probabilities are that the termites will in time penetrate it and if it be *Coptotermes* they may even dissolve away the metal by means of the acid secretion of the soldier and make their entry into the superstructure.

A device theoretically less satisfactory but much less expensive and more durable, one which avoids the engineering difficulty of completely severing the concrete pillar or wall, and which will probably be as effective consists of a similar arrangement which extends only a few inches into the concrete of the pillar or foundation wall. I am forced here to depend on the information which I receive from the cement engineer that cracks in pillars and foundation walls are superficial and that such a device would prevent entry through them. Such a device could be made of heavy galvanized iron, would be cheap, durable, and effective, and, I am told by architects, would be amenable to decorative treatment such as to prevent its marring the architectural effect.

Experiments to test the effectiveness of the termite shield as a protection against the American species of the genus *Reticulitermes* are projected by the Termite Investigations Committee (Light, 1929). Similar tests should be carried out in Manila where the densely infested Pandacan region offers a splendid opportunity and in Honolulu or Formosa where *Coptotermes formosanus* presents difficult problems.

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ILLUSTRATIONS

Plate 1

Coptotermes vastator sp. nov., head of alate to show head outline and antennæ, photomicrograph, × 50.

Plate 2. Coptotermes vastator sp. nov., Photomicrographs.

Fig. 1. Portion of head capsule of alate, greatly enlarged to show ocellus, antennal spot, antennal fossa, a few facets of the compound eye, and the first segments of the antennæ, × 771.
2. Head of alate to show surface structures, × 43.
3. Pronotum of alate, × 43.
4. Base of forewing, × 43.
5. Base of hindwing, × 43.

Plate 3

Coptotermes vastator sp. nov., photomicrograph of entire forewing, × 20. Note the absence of a costal strip and the very slight pigmentation distal to the suture.

Plate 4

Coptotermes vastator sp. nov., photomicrograph of mandibles of alate, × 140.

Plate 5. Coptotermes vastator sp. nov., Alate, Photomicrographs.

Fig. 1. Foreleg, × 140.
2. Region of fontanel, × 795.

Plate 6. Coptotermes vastator sp. nov., Soldier, Photomicrographs.

Fig. 1. Head, dorsal view, ca. × 28.
2. Left mandible, ca. × 80.
3. Antenna, left mandible, and labrum, ca. × 35.

Plate 7. Photographs of Work of Coptotermes vastator sp. nov. in Wood of Box in Basement of University Hall, University of the Philippines, Manila, P. I.

Fig. 1. Thin superficial layer torn away to show workings and frass.
2. End of sawed portion of same, somewhat enlarged.

Plate 8. Photograph of Work of Coptotermes vastator sp. nov. in Cattle Sheds of the Pandacan Quarantine Station, Manila, P. I.

Fig. 1. Roof of one the sheds showing covered runways on timber.
2. Portion of nest taken from these boards, enlarged.

PLATE 9. WORK OF COPTOTERMES VASTATOR SP. NOV. IN CATTLE SHEDS OF THE PANDACAN QUARANTINE STATION, MANILA, P. I.

FIG. 1. Covered runway built down a concrete pillar of cattle shed, retouched.

2. Portion of board removed from roof of cattle shed showing nest structure, enlarged.

3. Portion of manger in cattle shed showing earthen galleries running from a crack in the concrete over the concrete manger to the pillars of hardwood through which termites built passageways to the lauan timbers of the roof.

TEXT FIGURES

FIG. 1. *Coptotermes vastator* sp. nov. alate, head capsule in dorsal view, ca. × 60.

2. *Coptotermes vastator* sp. nov. alate, sketch of forewing.

3. *Coptotermes vastator* sp. nov., head of soldier from type colony, dorsal view.

4. *Coptotermes vastator* sp. nov., head of soldier, side view.

5. *Coptotermes formosanus* Shiraki, from Honolulu, forewing. Note that it is larger than the forewing of *C. vastator* (see fig. 2 drawn to the same scale) and has more pigment at the base and in the form of a "costal stripe."

6. The termite shield in crude practical form for small houses as in use in certain parts of California. Kindness of California-Hawaiian Sugar Refinery, Crockett, California.

7. Plans for protection of buildings against subterranean termites. Modified slightly from plans issued by Mr. Walter Putnam, city superintendent of buildings, Pasadena, California. Used by permission of Mr. Putnam.

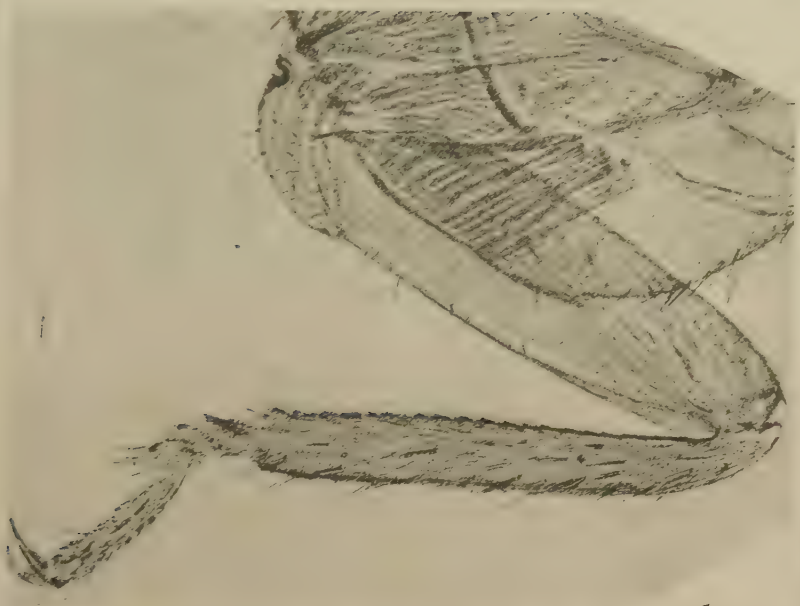
8. Plans for protection of stucco building against subterranean termites. Modified from plans issued by Mr. Walter Putnam, city superintendent of buildings, Pasadena, California. The chief modification is in ending the stucco at the upper level of the concrete foundation. The color scheme may be preserved by a wash on the foundation surface to correspond with the stucco.

PLATE 1.

PLATE 2.

PLATE 3.

PLATE 4.



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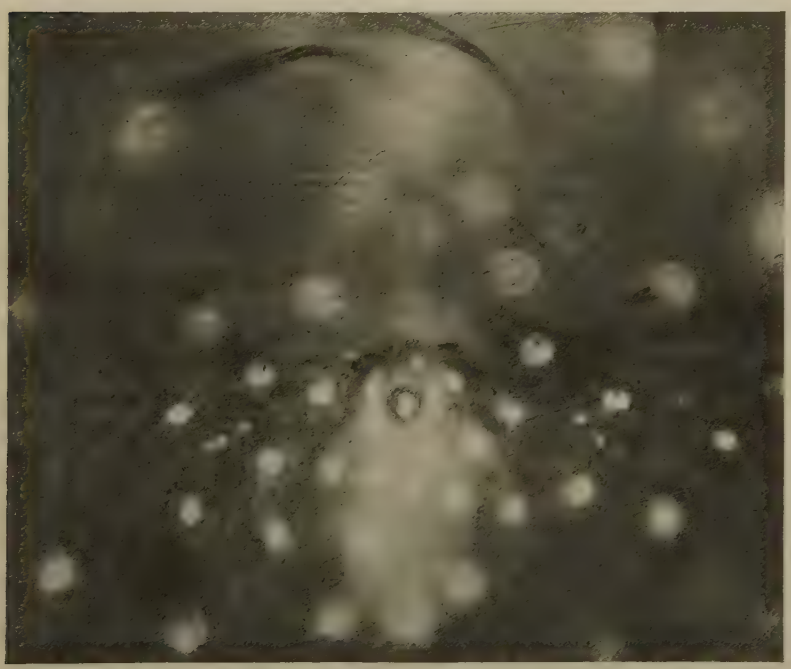

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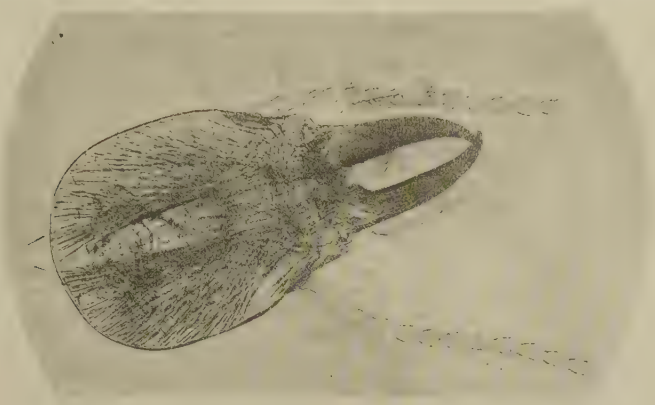

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2

3

PLATE 6.

1

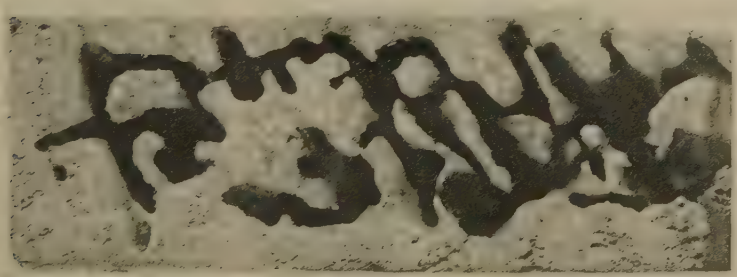

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PLATE 7.

1

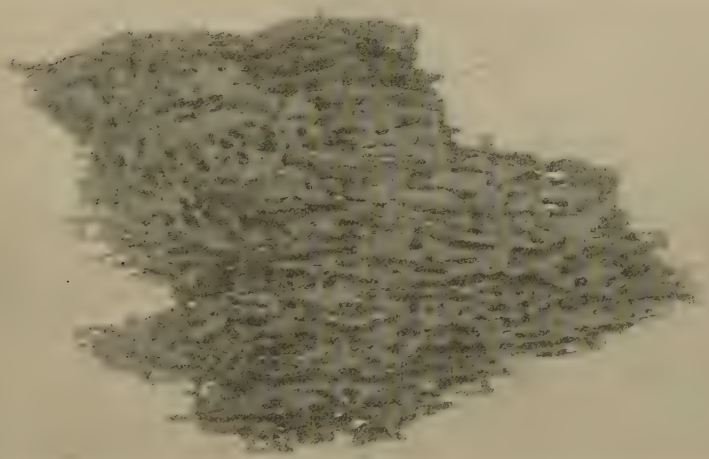

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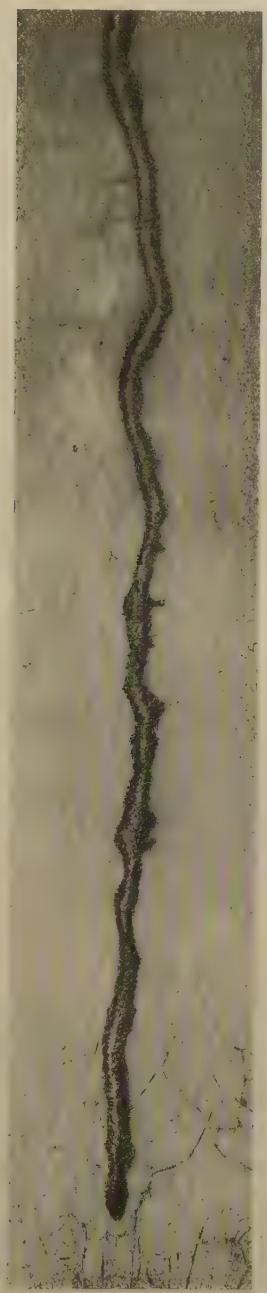
PLATE 8.



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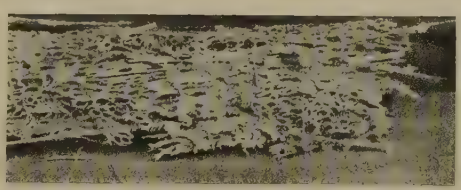


2

PLATE 9.

DIE ANTHICIDEN DER PHILIPPINEN, II

Von H. Krekich-Strassoldo

Graz, Austria

ZWEI TAFELN

Als ich den ersten Teil meiner Studie über die Anthiciden der Philippinen [1] veröffentlichte, lag mir im Wesentlichen nur dasjenige Material vor, das mir von Herrn Dr. Charles Fuller Baker in entgegenkommender Weise zur Verfügung gestellt worden war. Seitdem ist eine grosse Anzahl Anthiciden, die Herr Böttcher in den Kriegsjahren auf den Philippinen sammelte, teils direkt in meinen Besitz übergegangen, teils mir von Museen Deutschlands zum Studium überlassen worden.

Die Durchsicht dieses wertvollen Materials ergab eine stattliche Anzahl neuer Arten und neuer Fundorte bereits bekannter Arten und soll das Ergebnis meiner Untersuchungen in den nachfolgenden Zeilen niedergelegt worden. Hiebei halte ich mich an die im ersten Teile meiner Arbeit eingehaltene Reihenfolge.

NOTOXUS

Auch in den neuen Fundergebnissen fand sich kein einziger Vertreter dieses Genus vor, so dass anzunehmen ist, dass es auf den Philippinen überhaupt nicht vorkommt.

MECYNOTARSUS

Herr M. Pic [2] hat zwei *Mecynotarsus* aus Manila beschrieben: *Mecynotarsus humeralis* und *Mecynotarsus baeri.*

Ich habe 21 Mecynotarsus, die in den Monaten März bis Mai in Manila erbeutet wurden, untersucht. Diese Art ist sehr veränderlich in der Färbung; ganz dunkle und ganz lichte Färbung mit zahlreichen Zwischenstufen wechseln ab. Es war mir nicht möglich, einwandfrei zu bestimmen, um welche der zwei von Pic beschriebenen Arten es sich handelt. Nach dem Autor soll sich *M. baeri* vom *M. humeralis* durch das längere Horn unterscheiden. Dieses Merkmal ist aber nicht massgebend, da die ♂ ♂

[1] Philip. Journ. Sci. 27 (1925) 515–535, 3 pls.

[2] Ann. Soc. ent. France (1902) 643, 644.

ein längeres, die ♀ ♀ ein breiteres kürzeres Horn aufweisen. Ich neige daher der Ansicht zu, dass wir es mit einer einzigen Art zu tun haben, der der zuerst publizierte Name: *Mecynotarsus humeralis* Pic zukommt.

FORMICOMUS (ORTHAUCHEN)

Formicomus bifasciatus Pic von Böttcher in folgenden Lokalitäten erbeutet; N. Luzon: Kalinga (I [3]), Lubuagan (I), Buranao (V), Cabugao-Imugan (4,000 Fuss, VI, VII); Montalban (III).

FORMICOMUS INGENS sp. nov.

Gross, schwarz mit metallischem Glanze, nur die Beine und namentlich die Tarsen mit blutrotem Scheine. Grösser als *F. bifasciatus* Pic, wie dieser mit zwei, aus weissen Haaren bestehenden Binden auf den Flügeldecken, Beide Binden sind jedoch wenig dicht und von der Naht weit entfernt.

Kopf glänzend, grob und zerstreut punktiert, mit abstehenden dunklen kürzeren und längeren Borstenhaaren nicht dicht bekleidet. Augen gross, vorstehend, gerandet; längs des oberen Augenrandes eine seicht Rinne. Fühler sehr lang und sehr schlank; zweites Glied sehr kurz, Endglied etwas länger als das zehnte. Halsschild länger als breit, vorne gerade und so breit wie der Kopf mit den Augen; covex, knapp vor dem Basalrande geschmälert; Seiteneindruck breit, seicht; glänzend, mit einer *vollständigen Längsrinne;* vorne kaum, gegen die Basis gröber punktiert und querrunzelig. Einzelne abstehende weisse Borstenhaare.

Flügeldecken eiförmig; Basis zu den kurz gerundeten Schulterecken leicht abfallend; kein Posthumeraleindruck: Omoplaten nicht erhoben. Sehr zerstreut und fein punktiert und ausser den weissen Bindenhaaren mit dunklen Borstenhaaren spärlich bekleidet.

Beine sehr lang und kräftig. Vorderschenkel des ♂ an der Unterseite in der proximalen Mitte mit einem kurzen scharfen Dorne; die Vordertibien des ♂ sind an der Unterseite in der distalen Hälfte lappenförmig länglich ausgezogen und vor der bedornten Spitze kurz und leicht eingebuchtet.

Unterseite dunkel-bis rotbraun, glänzend, fein punktiert und fein behaart. Sichtbares Endsternit breit eingedrückt, mit

[3] Die römischen Zahlen bedeuten den Monat des Fanges.

einem dreispitzigen dunklen Lappen in der Mitte; unterhalb des Lappens ragt ein harpunenartiger Fortsatz hervor.

7 Millimeter.

Socorro. Ein-♂ in meiner Sammlung.

Offendar dem *F. insignis* (olim *maximus* Pic) nahestehend, jedoch als neue Art zu betrachten da in der Beschreibung des *F. insignis* der auffallenden Längsrinne am Halsschilde keine Erwähnung geschieht. Eine solche Rinne hat auch *F. albopictus* Kr.; dieser weist jedoch nur eine (vordere) weisse Haarbinde an den Flügeldecken auf.

FORMICOMUS BISPINOSUS Kr.

Formicomus bispinosus Kr., Philip. Journ. Sci. 27 (1925) 518.

Böttcher fand in Surigao (VIII, IX) einige Exemplare dieser Art, die nur eine (die vordere) aus weissen Haaren bestehende Binde aufweisen. Die Gestalt des sichbaren Endsternites ist etwas verschieden von der Type, weshalb ich die betreffende Zeichnung bringe. Die ebenfalls von Böttcher in Dapa, Siargao (X), und Cabuntog, Surigao (IX), erbeuteten *F. bispinosus* haben dagegen zwei aus weissen Haaren geformte Binden an den Flügeldecken.

FORMICOMUS BÖTTCHERI sp. nov.

Dem *F. bifasciatus* Pic in der Gestalt und Färbung ausserordentlich ähnlich, jedoch schlanker und hauptsächlich dadurch auseinanderzuhalten, dass die Vorderschenkel des ♂ an der Innenseite keinen langen Dorn aufweisen, sondern höchstens eine leichte, spitze Anschwellung. Der Halsschild hat oberhalb des Basalrandes nicht 2 von einander entfernte Gruben, sondern eine quere glatte Einkerbung. Die Flügeldecken sind etwas schmaler und weniger dicht punktiert. Die vordere, aus weissen Haaren gebildete Binde ist schmaler und gegen die Naht zu kürzer. Die Beine weniger kräftig, rot durchscheinend.

Unterseite dunkelbraunrot, fein chagriniert und mit dünnen, gelblichen Härchen bekleidet.

5.6 Millimeter.

Mindanao: Surigao (II) (*Böttcher*).

FORMICOMUS CONSOCIATUS sp. nov.

Dem *F. bispinosus* Kr. und *bifasciatus* Pic ähnlich, jedoch spezifisch verschieden und eher mit dem *F. appendicinus* Kr. verwandt.

Gross, schlank; Kopf, Halsschild und Beine schwarz mit blutrotem Schimmer; Flügeldecken ganz blau, glänzend, mit einer, aus weissen, zottigen, unregelmässig stehenden Haaren gebildeten, die Naht nicht erreichenden Querbinde im ersten Drittel.

Kopf eiförmig. Augen gross, ohne Randleiste, mässig vorstehend; Schläfen gleich hinter den Augen vermindert und in den langen Hals übergehend. Mit feinen Längsrippen bedeckt und mit feinen weissen Haaren längs und quer bekleidet; überdies einige abstehende Borstenhaare. Wenig glänzend. Fühler sehr lang, bis zum ersten Drittel der Flügeldecken reichend; alle Glieder—das zweite, sehr kurze ausgenommenfast von der gleichen Länge; Endglied etwas länger als das zehnte, spindelförmig.

Halsschild etwas länger als der Kopf mit dem Halse, wenig schmaler als der Kopf; vor der Basis leicht eingeschnürt, mit kräftigem, queren Seitene indrucke. Glatt, glänzend; zerstreut, nur gegen die Basis dichter und auch kräftiger punktiert; mit sehr feinen, bräunlichen Haaren, von denen wenige abstehen, spärlich bedeckt.

Flügeldecken länglich-elyptisch, etwa ein und ein halb mal so lang als der Kopf mit dem Halsschilde. Basis leicht zu den spitzen Schulterecken abfallend; an den Seiten gegen die Mitte mässig breiter. Kein Posthumeraleindruck. Omoplaten nicht erhoben. Schildchen länglich, spitz, in der Mitte eingedrückt. Kein Nahtstreifen. Fein und zerstreut punktiert und mit gelblichen, teilweise in Reihen stehenden, nicht ganz anliegenden Haaren sparsam bekleidet.

Beine sehr kräftig; alle Tibien und Tarsen dicht behaart. Vorderschenkel des ♂ mit starkem, leicht abgestutzten Zahne innen in der Mitte; die Vordertibien des ♂ distal verdickt und vor der Spitze scharf eingebuchtet.

Unterseite dunkelrotbraun, ziemlich glänzend; fein und dicht punktiert und fein gelblich behaart. *Am zweiten Sternit des ♂ zwei abstehende dornartige Fortsätze;* das sichtbare Endsternit des ♂ hat in der Mitte ein kugelförmige Erhebung.

7.5 Millimeter.

Mindanao: Mumungan. Buranan (V) (*Böttcher*).

FORMICOMUS EXCAVATUS Kr.

Formicomus bakeri Kr., Philip. Journ. Sci. 27 (1925) 519.

Es liegt mir ein ♂ aus der Insel Basilan und ein ♀ aus Zamboanga, Mindanao, vor. Beide mit deutlicher Längsrinne in der Mitte des Halsschildes und mit Gruben beiderseits des Vorderlobus desselben; allerdings sind diese Gruben weniger ausgeprägt.

Die Vorderschenkel des ♂ sind nicht bedornt, dagegen die Vordertibien an der Innenseite in der Mitte leicht geschwollen und vor der bedornten Spitze schwach eingebuchtet.

Ich bringe die Endsegmente und den Penis des ♂.

FORMICOMUS BAKERI Kr.

Formicomus bakeri Kr., Philip. Journ. Sci. 27 (1925) 519.

Auch von diesem *Formicomus* vermag ich heute die Zeichnung der Endsegmente des ♂ zu bringen.

FORMICOMUS HASTATUS sp. nov.

Gedrugen, gewölbt, glänzend; ganz dunkelrotbraun, die Flügeldecken mit metallischem Schimmer.

Kopf länglich-elyptisch; Augen gross, vorstehend; vor den Fühlerwurzeln erhobene, an der Stirne sich vereinigende Leistchen. Schläfen ziemlich lang und leicht convergierend, um, mit geringem Absatze, in den Hals einzumünden. Sehr zerstreut, eher grob punktiert und mit lichten kurzen Haaren sparsam bekleidet. Fühler sehr lang und kräftig; Endglied etwas länger als das zehnte, wenig spitz. Halsschild um die Hälfte länger als breit, etwas schmaler als der Kopf, stark gewölbt. Knapp vor der Basis eingeschnürt; Seiteneindruck kräftig. Oberhalb der Basis eine quere scharfkantige Erhebung; der Raum zwischen dieser und dem Basalrande sehr glatt und glänzend. Fein und sehr zerstreut punktiert, nur gegen die Einschnürung zu etwas rauher und quer; am vorderen Teile des Halsschildes eine schmale Längsrippe in der Mitte. Mit lichten, zum Teile ganz abstehenden kurzen Borstenhaaren schwach bekleidet.

Flügeldecken kurz (kaum ein und ein viertel mal so lang als der Kopf mit dem Halsschild) und um die Mitte sehr erbreitet. Basis zu den spitzen Schulterecken leicht abfallend. Kein Posthumeraleindruck. Omoplaten nich erhoben. Nahtstreifen kaum angedeutet. Sehr fein und sehr zerstreut punktriet und mit gelblichen Haaren sparsam bedeckt.

Beine lang, kräftig; alle Schenkel sehr verdickt. Vorderschenkel des ♂ mit langem spitzen-zahn in der Mitte der Unterseite; Vordertibien des ♂ distal breitlappig ausgezogen und vor der bedornten Spitze eingebuchtet; der Lappen trägt lange abstehende Haare. Unterseite dunkelbraum; Mittelbrust dicht chagriniert; sonst fein punktiert und schwach behaart.

4 Millimeter.

Iligan.

FORMICOMUS (VERUS)

FORMICOMUS PRIMITIVUS Kr.

Formicomus primitivus Kr., Philip. Journ. Sci. 27 (1925) 520.

Neue Fundorte: Mindanao: Mumungan (*Böttcher*). Negros: Cuernos Mountains (*Baker*).

FORMICOMUS SIMULANS sp. nov.

Ungefähr von der Grösse unseres *F. pedestris.* Rossi. Glänzend, Kopf und Halsschild dunkelrotbraum bis schwarz, Flügeldecken schwarz mit bronzegrünem Schimmer, Mundteile, Fühler und Beine dunkelrostrot.

Kopf etwa so lang als breit. Augen gross, vorstehend; Schläfen kurz und gleich hinter den Augen zur breitbogigen Basis vermindert. Ziemlich grob und zerstreut punktiert, längs der Augen gerunzelt, mit gelben zum Teile abstehenden Borstenhaaren spärlich bekleidet. Fühler schlank, bis über die Schultern reichend; alle Glieder, mit Ausnahme des zweiten viel kürzeren, ungefähr von der gleichen Länge; Endglied ein wenig länger als das zehnte. Hals dick, Kragen breit.

Halsschild länger als der Kopf, aber deutlich schmaler als dieser. An den Seiten knapp vor der Basis schwach eingedrückt; Seiteneindruck lang, ziemlich scharf. Zerstreut, nicht grob punktiert; in der Mitte zuweilen feine Längsrinnen. Wie der Kopf behaart.

Flügeldecken ein und einhalb mal so lang als der Kopf mit dem Halsschilde. Basis fast gerade. Schulterecken kurz gerundet. An den Seiten um die Mitte deutlich breiter; Spitzen bogenartig abgestutzt. Ziemlich flach. Kein Posthumeraleindruck. Nahtstreifen kaum angedeutet. Sehr fein und sehr zerstreut punktiert und mit gelblichen nicht ganz anliegenden Haaren spärlich be kleidet; überdies wenige kurze, ganz abstehende Haare.

Beine sehr kräftig, Schenkel stark verdickt. *Das ♂ hat einfache Vorderschenkel und Vordertibien.*

Die Unterseite ist schwarz, lederartig, fein punktiert und teilweise chagriniert und mit kaum sichtbaren dunlken Härchen bedeckt. Das letzte vorstreckbare Tergit endet in *2 starke lederförmige, sehwarze, grob punktierte Lappen, die gewöhnlich vorstehen.* Das letzte sichtbare Sternit ist stark ausgebuchet und in der Mitte halbmondförmig ausgehöhlt.

3.6–4 Millimeter.

Mindanao: Mumungan (*Böttcher*).

Zur Gruppe *primitivus gehörig.*

FORMICOMUS DUBIUS sp. nov.

Dem *F. simulans* äusserlich ausserordentlich ähnlich, ja von diesem kaum unterscheidbar. Dennoch durch die abweichende Gestaltung der Endsegmente und namentlich dadurch typisch verschieden, dass die breiten lederförmigen Lappen des letzten vorstreckbaren Sternites fehlen und durch feinhäutige, leicht gedunkelte, stark behaarte Anhänge ersetzt sind. Auch das letzte sichtbare Sternit ist nicht ausgebuchtet und ausgehöhlt.

4 Millimeter.

Mindanao: Tangkulan.

FORMICOMUS CONFRATER sp. nov.

Ganz dunkelbraun, Kopf und Halsschild mit metallischen, Flügeldecken mit grünlichem Glanze.

Kopf kaum länger als breit, kreisrund, gewölbt; Augen mässig vorstehend. Kräftig, aber zerstreut punktiert; aus jedem Punkte entspringt ein feines gelbliches Haar; überdies wenige abstehnde Borstenhaare. Fühler lang, sehr kräftig, alle Glieder, bis auf das zweite viel kürzere, ungefähr von der gleichen Länge.

Halsschild etwas schmaler als der Kopf, doppelt so lang als breit, knapp vor dem Basalrande an den Seiten leicht eingedrückt. Seiteneindruck breit, nicht tief. Oberhalb des Basalrandes quer gerunzelt, sonst fein und zerstreut punktiert; wie der Kopf behaart.

Flügeldecken ein und ein halb mal so lang als Kopf mit dem Halsschilde; an den Seiten um die Mitte wenig breiter. Spitzen abgestutzt. Basis gerade. Schulterecken spitz. Schulterbeule angedeutet. Omoplaten nicht erhoben. Kein Nahtstreifen. Sehr fein und zerstreut punktiert und mit wenigen, nicht ganz anliegenden lichten Borstenhaaren spärlich bedeckt.

Beine lang, schlank; Schenkel sehr keulig. *Vorder schenkel und Vordertibien ♂ einfach.*

4.5 Millimeter.

Negros: Cuernos Mountains.

FORMICOMUS ABRUPTUS sp nov.

Mässig gross, schwarz, nur die ersten Fühlerglieder, die Tibien und Tarsen mit einem blutroten Stich; Flügeldecken leicht irisierend.

Kopf länglich-oval. Augen gross, vorstehend, leicht nach aufwärts gerichtet. Schläfen gleich hinter den Augen zur schmalen Basis convergierend. Hals kurz, vom Kopfe leicht abgesetzt. Crob und zerstreut punktiert und leich längsgeript. Mit kur-

zen abstehenden Haaren nicht dicht bedeckt. Fühler ziemlich lang, alle Glieder, bis auf das zweite viel kürzere, ungefähr von der gleichen Länge.

Halsschild schmaler als der Kopf, mehr als doppelt so lang als breit, vor der Basis schwach eingeschnürt. Seiteneindruck tief und breit. Vor der Basis querunzelig und mit einigen Längskerbungen, sonst fein und zerstreut punktiert und sehr schwach behaart.

Flügeldecken ein und ein halb mal so lang als der Kopf mit dem Halschilde, an den Seiten um die Mitte wenig breiter; Spitzen leitch abgestutzt. Basis fast gerade. Schulterecken spitz. Deutliche Schulterbeule. Kein Posthumeraleindruck. Nathstreifen kaum im letzten Drittel angedeutet. Sehr zerstreut und sehr fein punktiert; kaum behaart.

Beine lang, schlank; Schenkel mässig verdickt. *Vorderschenkel und Vordertibien des ♂ einfach.* Unterseite dunkelbraun, sehr glänzend; kaum punktiert und behaart.

4 Millimeter.

Insel Samar.

FORMICOMUS CONSPICIENDUS sp. nov.

Gross, schlank, ganz dunkelbraun bis schwarz, Flügeldecken mit grünlichem Schimmer.

Kopf länglich-elyptisch; Augen ziemlich gross und vorstehend. Schläfen lang. Clypeus mit schmal erhobenen Rändern. Dicht längsgekerbt, dazwischen grob punktiert. Unscheinbar behaart. Fühler kräftig und bis über die Schultern reichend (die Endglieder fehlen auf dem einzigen vorliegenden Exemplar).

Halsschild doppelt so lang als breit; Vorderlobus an den Seiten wenig erbreitet; mit Andeutung einer Mittelrinne. Seiteneindruck flach, darinnen dicht punktiert; sonst fein und zerstreut punktiert, daher glänzend; kaum behaart.

Flügeldecken mehr als doppelt so lang, als um die Mitte breit. Spitzen leicht abgestutzt. Basis zu den kurz gerundeten Schulterecken leicht abfallend; keine Schulterbeule; kein Posthumeraleindruck; Schildchen länglich-spitz. Sehr glänzend, kaum punktiert und behaart.

Beine kräftig. Schenkel sehr verdickt. Vorderschenkel des ♂ breitlappig in der inneren Mitte ausgezogen; Vordertibien des ♂ innen in der Mitte zahnartig erweitet. Unterseite dunkelrotbraun. sehr glänzend, *zwei spitze Fortsätze an der Basalmitte des ersten Sternites.*

4.7 Millimeter.

Manila.

Aehnliche Fortsätze am ersten order zweiten Sternit haben *F. consociatus* Kr. aus Mindanao, Mumungan, *F. appendicinus* Kr. aus Luzon, Montalban Gorge, und *F. longithorax* Kr. aus Los Baños.

FORMICOMUS LONGITHORAX Kr.

Formicomus longithorax KR., Philip. Journ. Sci. 27 (1925) 522.

Böttcher hat in Los Baños (VIII) einen *Formicomus* erbeutet, der das ♂ des von mir beschriebenen (♀) *F. longithorax* sein dürfte, obwohl er viel grösser (fast 8 Millimeter) ist.

Dieses ♂ ist dem *F. appendicinus* Kr. auch dadurch äusserst ähnlich, dass das erste Ventralsegment in der Mitte *zwei nach abwärts gerichtete, stark borstig behaarte und enger als beim F. appendicinus bei einanderstehende dornartige Fortsätze* aufweist.

FORMICOMUS PUMICATUS sp. nov.

Sehr glänzend. Kopf und Halsschild schwarz, Flügeldecken schwartz mit bronzegrünem Schimmer. Mundteile, Fühler und Beine dunkelrostrot.

Kopf länglich-oval. Augen gross, ziemlich vorstehend und leicht nach oben gerückt. Schläfen lang, gleich hinter den Augen mässig abnehmend. Basis kurz gerundet. Ueberall dicht längs-gerippt, dazwischen mit zerstreuten Ocellenpunkten, woraus feine, dunkle, abstehende Haare entspringen. Der Kopf ist überdies mit kurzen, dunklen, nicht anliegenden Haaren dicht bekleidet. Die Stirne ist nicht abgeflacht. Fühler schlank, die Schultern erreichend: alle Glieder, mit Ausnahme des kürzeren zweiten Gliedes, ungefähr von der gleichen Länge; Endglied kegelförgmig, spitz

Halsschild länger aber etwass schmaler als der Kopf, leicht gewölbt, kurz vor der schmalen Basis mässig eingeschnürt, Seiteneindruck breit und ziemlich tief. Stark und zerstreut punktiert, vor der Basis dicht gerunzelt. Mit feinen, nicht anliegenden, gelblichen Haaren ziemlich sparsam bedeckt.

Flügeldecken etwa ein und ein halb mal so lang als der Kopf mit dem Halsschilde. Basis gegen die kurz gerundeten Schulterecken leicht abfallend. An den Seiten um die Mitte mässig erbreitet, gegen die Spitzen deutlich verschmälert. Kein Posthumeraleindruck. Schulterbeulen deutlich. Mit zerstreuten Ocellenpunkten, dazwischen mit feinen Punkten nicht dicht bedeckt; aus den Ocellen entspringen gelbliche längliche, nicht anliegende Haare; dazwischen wenige ganz aufrechte Haare.

Schildchen länglich spitz. Nahtstreifen im letzten Drittel sehr schwach angedeutet.

Beine kräftig mit sehr verdickten Schenkeln. Vorderschenkel des ♂ mit einem starken zumeist abgestumpften Dorne an der Innenseite in der Mitte; die Vordertibien des ♂ sind distal hinter der Mitte innen leicht eingebuchtet. Alle Fusswurzeln heller braunrot. Unterseite glänzend, wiewohl etwas dichter punktiert; Sternite verworren, teilweise runzelig punktiert. Gelb, nicht anliegend nicht dicht behaart.

4.2–4.8 Millimeter.

Mindanao: Mumungan (*Böttcher*).

FORMICOMUS ROUYERI Pic.

Formicomus rouyeri PIC, Bull. Soc. Zool. de France (1914) 183.

Ich bringe die Zeichnung der Endsegmente auch dieses *Formicomus*, nach einem in Bataan Lamao (Luzon) erbeuteten, von Herrn Pic selbst determinierten Exemplare.

FORMICOMUS FOEDERATUS sp. nov.

Von der Grösse des *F. braminus*. Ganz rotbraun, nur die Flügeldecken schwarz mit grünem Glanze (Die Basis bleibt mehr oder weniger rotbraun) Tibien gebräunt. Glänzend. Schlank.

Kopf kaum länger als breit. Augen mässig gross und wenig vorstehend. Schläfen gleich hinter den Augen vermindert; Basis schmal gerundet. Dicht punktiert und längs-gerunzelt. Mit kurzen Borstenhaaren und einigen abstehenden feinen Haaren spärlich bekleidet. Fühler schlank, bis über die Schultern reichend; Endglied etwas länger als das zehnte, spitz.

Halsschild schmaler als der Kopf, fast doppelt so lang als um die Mitte breit. Seiteneindruck breit, nicht tief. Schwach und zerstreut, nur vor der Basis dichter punktiert. Mit feinen weissen, anliegenden und wenigen abstehenden Haaren bedeckt.

Flügeldecken doppelt so lang als um die Mitte breit. Basis zu den schmal gerundeten Schulterecken leicht abfallend. Kein Posthumeraleindruck. Schildchen länglichspitz, in der Mitte eingedrückt. Kein Nahtstreifen. Sehr fein und zerstreut punktiert und mit weisslichen anliegenden und abstehenden Haaren spärlich bekleidet.

Beine kräftig, Schenkel sehr verdickt. Vorderschenkel des ♂ an der Innenseite breit zu einem stumpfen Zahne ausgezogen; die stumpfe Kante ist mit kleinen Dornen versehen. Vordertibien des ♂ einfach.

4.2–4.5 Millimeter. Mindoro: San Teodoro (I) (*Böttcher*).

FORMICOMUS LEPIDUS sp. nov.

Klein, sehr glänzend; Kopf, Halsschild und Beine rötlichbraun (Kopf etwas dunkler); Fühler gelbbraun, die drei letzten Glieder verdickt und gedunkelt. Basis der Flügeldecken rötlichbraun; Flügeldecken sonst scharzbraun mit Ausnahme einer ziemlich breiten, zumeist an der Naht unterbrochenen und fast bis zum Seitenrande reichenden lichtgelben Binde.

Kopf kaum länger als breit; gleich hinter den grossen, vorstehenden Augen zum schmalen Basalrande vermindert. Zerstreut, eingestochen punktiert und mit gelblichen, teilweise abstehenden Haaren spärlich bekleidet.

Halsschild vorne stark erhoben; so breit als der Kopf bei den Augen. Sehr kräftiger, nach oben und aufwärts fortgesetzter Seiteneindruck. Basalrand schmal, lichter gelb. Fein und nur im Seiteneindrucke und vor der Basis etwas dichter punktiert und mit teilweise abstehenden Haaren spärlich bedeckt.

Flügeldecken weniger als ein und ein halb mal so lang als der Kopf mit dem Halsschild; an der Basis zu den ziemmlich breit gerundeten Schulterecken schräg abfallend; an den Seiten um die Mitte deutlich breiter; Spitzen gemeinsam gerundet. Schildchen länglich, spitz. Omoplaten leicht erhoben. Posthumeraleindruck deutlich. Ausserordentlich fein und zerstreut punktiert; aus den Punkten entspringen feine, gelbliche, fast anliegende Borstenhaare.

Vorderschenkel des ♂ geschwollen, mit einem langen Dorne an der Innenseite in der Mitte; Vordertibien des ♂ an der Unterseite ausgezogen und kantig abgesetzt. Unterseite rotbraun bis schwarzbraun, sehr glänzend, sehr fein punktiert und kaum behaart.

2.8–3 Millimeter.

Calapan (II) (*Böttcher*).

GRUPPE FORMICOMUS BRAMINUS LAFERTÉ

Eine ganze Reihe von asiatischen *Formicomus*, sowohl aus Vorder- als auch aus Hinter-Indien, aus Ceylon, China, Japan, dann auch aus dem malayischen Archipel figuriert in den verschiedentsten Sammlungen als *F. braminus* Laferté.[4] Genauere Untersuchungen ergaben so bedeutende Verschiedenheiten in dem Baue der Endsegmente dieser *Formicomus* verschiedener Heimat, das sich eine gründliche Revision als unumgmänglich notwendig erweist.

[4] Monographie (1848) 79.

Zu diesem Ende handelt es sich zunächst darum, festzustellen, *welcher Formicomus* als der *typische F. braminus* Laferté's anzusehen sei, ein Beginnen, dass um so schwieriger erscheint, als einerseits die Beschreibung Laferté's auf ein aus "Indien," ohne nähere Fundortbezeichnung stammendes Exemplar fusst, andererseits dem Autor 7 "indische" Exemplare in abweichenden Färbungen vorlagen; überdies erwähnt Laferté, dass sich unter den 7 Exemplaren nur ein einziges ♂ befand, dessen Abdomen keine Einbuchtung und dessen. Vorderschenken keinen Dorn aufwiesen. Offenbar hat Laferté überhaupt kein ♂ zu Gesicht bekommen, da unterschiedslos alle ♂ dieser und aller verwandten Arten bedornte Vorderschenkel aufweisen.

Unter den vielen Hunderten *F. braminus* (sensu lato), die mir untergekommen sind, passt am besten die Beschreibung Laferté's auf einen F. der Motschulsky'schen Sammlung in Moskau, dessen patria allerdings auch nur mit "India orientalis" angegeben ist. Es ist nicht unwahrscheinlich, dass Laferté und Motschulsky den *F. braminus* aus derselben Quelle hatten und so glaube ich, diesen *Formicomus* der Motschulky' schen Sammlung als den typischen *F. braminus* anspreshen zu dürfen. Zur Berkräftigung meiner Ansicht diene der weitere Umstand, dass ein aus den Ausbeuten Helfer's stammendes Exemplar aus Tenasserim eine conforme Gestaltung der Endsegmente aufweist. Laferté besass aber Anthiciden, die Helfer gesammelt hatte.

Ich bringe nun die Zeichnung der Endsegmente und des Penis des Exemplar's aus der Motschulky'schen Sammlung, welche, wie erwähnt mit denen eines Exemplar's aus Tenasserim identisch sind.[5] Hiemit ist ein fixer Ausgangspunkt gegeben, von welchem aus ich diese weit verbreitete Gruppe werde neu bearbeiten kömen. Ich beschränke mich im Rahmen der vorliegenden Studie diejenigen, dem *F. braminus* nahestehenden Arten zu beschreiben, welche bisher auf den Philippinen erbeutet worden sind.

FORMICOMUS PROTERVUS sp. nov.

Allgemeinfärbung braunrot bis blutrot, die Flügeldecken dunkler, eine schmale blutrote Quermakel unterhalb der Schultern freilassend. Glänzend.

[5] Die Gestaltung der Endsegmente der Formicomus-Arten ist oft so compliziert, dass die mikroskopischen Präparate namentlich alter Exemplare, je nach der Verschiedenheit der Lage der einzelnen Teile undeutliche und manchmal schwer zu erkennende Darstellugen bieten. In vielen Fällen bringe ich die einzelnen Teile der Endsegmente in verschiedenen Lagen, so auch hier. Die richtige Deutung kann nur durch Uebung erfolgen.

Kopf elyptisch-oval weniger länger als breit. Augen ziemlich gross und vorstehend; Schläfen länglich; Basis breitbogig. Zerstreut, occellenartig punktiert und mit gelblichen, teilweise ganz abstehenden Haaren nicht dicht bekleidet. Fühler lang, schlank, drittes bis elftes. Glied ungefähr von der gleichen Länge; Endglied spitz.

Halsschild weniger als ein und einhalb mal so lang als breit; vom Kragen schräg abfallend zur Mitte, wo der Halsschild die Breite des Kopfes hat; gegen die Basis abnehmend; Seiteneindruck breit und tief. Ziemlich gewölbt. Sehr zerstreut, teilweise grob punktiert und mit spärlichen Borstenhaaren spärlich bedeckt.

Flügeldecken ein und ein viertel mal so lang als der Kopf mit dem Halsschilde. Basis zu den spitzen Schulterecken leicht abfallend; an den Seiten um die Mitte mässig breiter. Posthumeraleindruck schwach angedeutet. Nahtstreifen äusserst schmal im lezten Drittel. Grob und zerstreut punktiert und mit gelblichen, nicht anliegenden, sowie mit einzelnen, ganz abstehenden Borstenhaaren sparsam bekleidet.

Beine, die Tibien inbegriffen, sehr kräftig und überall dicht gelblich behaart. Vorderschenkel des ♂ an der Unterseite in der Mitte zu einem breiten, etwas stumpfen Zahne ausgezogen; Vordertibien des ♂ gedunkelt und an der Unterseite in der Mitte leicht lappig erbreitet und von da bis zur Spitze mit kurzen Borstenhaaren und Dornen dicht bedeckt.

4 Millimeter.

Mindanao: Mumungan (*Böttcher*).

FORMICOMUS FRATERCULUS sp. nov.

Kopf und Halsschild rotbraun; Fühler und Beine dunkelrotbraun; Flügeldecken schwarzbraun mit gelblichroter, nicht bis zum Seitenrande reichender und auch an der Naht unterbrochener Posthuralblinde. Glänzend.

Kopf etwa so lang als bei den Augen breit. Diese gross und vorstehend. Hinter den Augen gleich zur kurzbogigen Basis vermindert. Ocellenartig, nicht dicht punktiert und mit lichten Haaren sparsam bedeckt. Fühler kräftig, zweites Glied sehr kurz; Endglied wenig länger als das zehnte.

Halsschild etwas länger als breit und so breit als der Kopf. An den Seiten vom Kragen aus bis knapp vor der Mitte schräg abfallend, dann ziemlich kräftig eingeschnürt. Leicht gewölbt. Seiteneindruck stark und breit. Wie der Kopf punktiert und behaart.

Flügeldecken um die Hälfte länger als der Kopf mit dem Halsschilde. Basis zu den ziemlich breit gerundeten Schulterecken leicht abfallend. Um die Mitte deutlich breiter; gegen die Spitze bogig sehr vermindert. Posthumeraleindruck kaum angedeutet. Mit groben zerstreuten und dazwischen mit feinen Punkten bedeckt und mit gelblichen längeren nicht anliegenden Haaren nicht dicht bekleidet.

Beine kräftig, alle Schenkel sehr verdickt. Vorderschenkel des ♂ an der Unterseite in der Mitte zu einem kräftigen Zahne ausgezogen; Vordertibien des ♂ distal leicht lappig verdickt und etwas geschwungen.

Unterseite rotbraun, glänzend, fein seicht punkiert und mit feinen gelblichen Haaren sparsam bekleidet.

3.8 Millimeter.

Mindanao: Kolambugan (II) (*Böttcher*).

FORMICOMUS AFFINIS sp. nov.

Grösser, sehr glänzend; Kopf und Halsschild gelbbraun, Flügeldecken schwarzbraun mit 2 kleinen rötlichen, undeutlich begrenzten Posthumeralmakeln. Beine dunkelbraun, die Wurzeln heller. (Fühler fehlen.)

Kopf etwas länger als breit. Augen sehr gross und sehr vorstehend. Schläfen länglich, Basis breitbogig. Vor den Fühlerwurzeln erhobene Leistchen, die sich vorne geradlinig vereinigen. Ocellenartig, zerstreut punktiert und mit gelblichen zum Teile abstehenden Harren sparsam bekleidet.

Halsschild gewölbt; um die Hälfte länger als breit, fast so breit als der Kopf. Seiteneindruck kräftig und breit. Grob nud zerstreut punktiert und wie der Kopf behaart. Flügeldecken mehr als ein und ein halb mal so lang als der Kopf mit dem Halsschilde. Basis zu den spitzen Schulterecken leicht abfallend. Um die Mitte deutlich breiter; Spitzen breitbogig vermindert. Ziemlich flach. Posthumeraleindruck angedeutet. Schildchen länglich, spitz. Nahtstreifen in der zweiten Hälfte deutlich, schmal. Sehr fein und sehr zerstreut punktiert und mit gelblichen, halb aufrechten Haaren nicht dicht bedeckt.

Beine sehr kräftig; Schenkel namentlich die vorderen sehr verdickt. Vorderschenkel des ♂ in der Mitte der Unterseite zu einem breiten abgestutzten Zahne ausgezogen; Vordertibien des ♂ in der distalen Mitte leicht lappig erweitert und vor der bedornten Spitze schwach eingebuchtet.

Unterseite rötlichbraun sehr glänzend; fein und zerstreut punktiert und licht, sparsam behaart.

4.8 Millimeter.

Mindanao: Surigao (XI) (*Böttcher*). Siargao (IX) (*Böttcher*).

Mit *F. castaneus* Kr. nahe verwandt.

FORMICOMUS TERMINATUS Pic.

Formicomus terminatus Pic, Echange (1895) 7, 9.

Da in den Sammlungen auch einige, als. *F. terminatus* determinierte Tiere vorkommen, so bringe ich die Zeichnung der Endsegmente eines F. aus Java (ohne nähere Ortsangabe), welchen Herr Pic selbst als sein *F. terminatus* bestimmte, und füge bei, dass mir ein F. mit gleichen oder ähnlichen Endsegmenten aus den Philippinen bisher nicht unterkam.

GRUPPE FORMICOMUS OBSCURUS PIC, OBSCURIOR PIC, RÖSELERI PIC

Es handelt sich hier um *Formicomus* Exemplare von der ungefähren Grösse unseres *F. pedestris* Rossi, von sehr veränderlicher Gestalt und Färbung, welche in den Sammlungen als *F. obscurus, obscurior,* und *röseleri* Pic bestimmt zu finden sind.

Der Durchsnittstypus ist durch folgende Merkmale ausgezeichnet: Allgemeinfärbung dunkelbraun bis schwarz, die Fühler etwas heller, ebenso die Beine; im ersten Drittel der Flügeldecken eine gelbe oder gelbrote Binde. Es kommen jedoch Formen vor mit geschwärzten Endgliedern der Fühler, mit geschwärzten Schenkeln und Tibien, endlich solche mit verminderter oder gänzlich fehlender heller Binde im ersten Drittel der Flügeldecken.

Ich habe bereits in meiner ersten Studie über die Anthiciden der Philippinen [6] auf die ausserordentliche Veränderlichkeit dieser *Formicomus* hingewiesen und die neuen Arten: *F. gratiosus* (3.6 Millimeter aus Basilan), *F. penangensis* (3 Millimeter aus Penang), *F. infuscatus* (3.5 Millimeter aus Tangkulan) und *F. iliganensis* (4 Millimeter aus Iligan) beschrieben.

Nun konnte ich neues sehr zahlreiches Material, namentlich aus den Böttcher'schen Ausbeuten genauer untersuchen und ich

[6] Philip. Journ. Sci. 27 (1925) 523.
[7] Loc. cit.

fand, dass die Endsegmente dieser äusserlich so sehr ähnlichen *Formicomus* so in die Augen springende Verschiedenheiten aufweissen, dass die Annahme gerechtfertigt sein dürfte, dass wir es hier möglicherweise auch mit Kreuzungen zu tun haben, wiewohl die bisherigen Untersuchungen und Erfahrungen *gegen* eine solche Annahme sprechen.

Jedenfalls fällt es schwer, gegenüber einer solchen Erscheinung Stellung zu nehmen, So sehr ich im Prinzipe der Schaffung neuer Arten ohne zwingende Notwendigkeit abhold bin, so kann ich dennoch angesichts der auffallenden Verschiedenheiten im Baue der Endsegmente nicht umhin, zur Aufstellung einer ganzen Raihe neuer Arten zu schreiten.

Es scheint mir aber wichtig, mich vorher noch mit jenen Arten zu beschäftigen, deren Namen den auf den Philippinen heimischen Arten häufig unzutreffenderweise gegeben worden ist. Am häufigsten finde ich solche *Formicomus* der Philippinen als *F. obscurus* und *obscurior* Pic bestiment.

Formicomus obcurus ist von M. Pic als ein auf Java sehr häufig vorkommende Art beschrieben worden [8] Die Beschreibung enthält keine besonderen, über die obige Summarbeschreibung des Durchschnittstypus hinausgehenden Merkmale, es wäre denn, dass die Augen grau und die Fühler kurz sind. Die Grösse wird mit 4-4.5 mm. angegeben. Der Autor sagt, dass *F. obscurus* dem ihm unbekannten *F. armatus* Bohem. nahesteht und erwähnt dass es Exemplare mit und solche ohne lichter Posthumeralbinde gibt.

Formicomus obscurior Pic wird als Varietät des *F. obscurus* von Herrn Pic folgendermassen beschrieben: "Eeytres depourvus de fascie antérierue rousse ou jaunâtre, et par consequence, à coloration uniforme d'un noir de poix ou brunâtre. Manila." [9]

Um nun den typischen *F. obscurus* aus Java genauer kennen zu lernen, habe ich mehrere Exemplare, die vom Autor selbst als *F. obscurus* diagnostiziert worden waren, untersucht. Ein solches Exemplar trägt keine genauere Fundortangabe, das zweite stammt aus dem Zuider-Gebirge (V), das dritte aus Tjilatjap (XII). Während bei allen diesen 3 Exemplaren das letzte sichtbare Sternit und der Penis ungefähr in der Gestalt übereinstimmen, weist die Gestalt der vorstülpbaren Endsegmente Verschiedenheiten auf, wie aus den Zeitchnungen zu ersehen, Dagegen zeigt ein viertes, von Herrn Pic gleichfalls als *F. obscurus*

[8] Le Natur (1894) 32.
[9] Ann. Soc. Ent. France (1902) 645.

determiniertes, aus Java (ohne näheren Fundort) stammendes Exemplar eine ganz abweichende Gestalt des sichtbaren Endsternites und der vorstülpbaren Endsegmente. Dieses letztere Tier gehört seinem Habitus nach eher zur *Braminus*-Gruppe.

Ich benutze diezen Anlass, um noch eines F. aus Banjoevangi (Java) zu gedenken, welcher von Herrn Pic einmal als *F. obscurus*, ein andermal als *F. javanus* (in litt.), determiniert wurde.

Es handelt sich hier um eine neue Art mit charakteristischen Endsegmenten, welcher der Name *Formicomus javanus* Pic zu belassen wäre. Zu bemerken ist nur, dass dieser F. zwei feine Rippen am Unterrande der Mittelbrust hat.

Aus dieser Darstellung geht hervor, dass Java, gleichwie die Philippinen eine stattliche Anzahl von einander mehr oder minder differenzierten, in ihrem Aeusseren dem *F. obscurus* (sensu lato) ähnelnden Formen aufweist und ferner, dass der Bau der vorstülpbaren Endsegmente dieser javanischen F. von denjenigen der ähnlichen philippinischen F. zumeist abweichen.

Um zunächst die die javanischen F. betreffenden Fragen abzuschliessen, möchte ich alle F., deren Endsegmente die Formen 1-3 zeigen als *F. obscurus* vorläufig subsummiert belassen, teils weil mir genügendes Material mangelt, um zu erkennen, ob diese an sich variablen Formen sich irgendwie stabilisieren und wenn auch vielleicht die Aufstellung neuer Arten, so doch die Erkennung von Lokalrassen rechtfertigen, teils weil bei der Komplizierheit der Endsegmente in der Darstellung möglicherweise Verzerrungen eintreten, die bei zahlreicheren Untersuchungsmaterial doch ein grössere Uebereinstimmung der Formen ergeben könnten.

Die zur Gruppe *F. obscurus* sensu lato gehörigen *Formicomus* der Philippinen sind die folgenden:

Formicomus röseleri PIC, Mitteil. Naturhist. Mus. Hamburg (1907) 178; KR., Philip. Journ. Sci. 27 (1925) 522, Taf. 3, fig. 10. 4–4.5 Millimeter. Luzon.

Formicomus gratiosus KR., Philip. Journ. Sci. 27 (1925) 523, Taf. 2, fig. 8. 3.6 Millimeter. Basilan.

Formicomus penangensis KR., Philip. Journ. Sci. 27 (1925) 524, Taf. 2, fig. 9. 3 Millimeter. Penang.

Formicomus infuscatus KR., Philip. Journ. Sci. 27 (1925) 524, Taf. 3, fig. 1. 3.5 Millimeter. Mindanao: Tangkulan.

Formicomus iliganensis KR., Philip. Journ. Sci. 27 (1925) 525, Taf. 3, fig. 2. 4 Millimeter. Mindanao: Iligan.

Ferner—

FORMICOMUS PLACIDUS sp. nov.

Posthumeralbinde breit, vollständig, rotgelb. Endglied der Fühler nicht länger als zehnte. Glied. Kopf und Halsschild grob und dicht punktiert, der Kopf auch teilweise gerunzelt, matter. Flügeldecken grob und zerstreut punktiert, glänzender Ueberall mit gelblichen, nicht anliegenden Borstenhaaren ziemlich dicht bekleidet. Vorderschenkel des ♂ mit wenig entwikkelter dorniger Anschwellung, Vordertibien (♂) leicht geschwungen und distal verdickt.

3.2 Millimeter.

Northern Palawan: Bacuit (XII).

FORMICOMUS IMPATIENS sp. nov.

Kopf, Halsschild und Beine dunkelrotbraun, Flügeldecken schwarzbraun mit einer schmalen, licht-rötlich-gelben, nicht bis zum Seitenrande reichenden und auch an der Naht schmal unterbrochenen Querbinde.

Halsschild und Flügeldecken glänzender als der Kopf, der gröber punktiert ist. Oberhalb der Augen Leistchen, die sich vorne vereinigen. Halsschild mit sehr starken Seiteneindrucke oberhalb des Basalrandes dicht und querrunzelig punktiert. Flügeldecken sehr zerstreut punktiert. Ueberall mit gelben nicht ganz anliegenden und wenigen ganz abstehenden Borstenhaaren bekleidet. Vorderschenkel des ♂ an der Unterseite in der Mitte zu eitnem etwas stumpfen Zahne stark ausgezogen; Vordertibien des ♂ distal geschwollen und knapp vor der gedornten Spitze deutlich abgesetzt.

Unterseite rotbraun, fein punktiert und mit sehr feinen Fransenhaaren siemlich reichlich bekleidet. Beim ♂ am unteren Rande der *Mittelbrust mit 2 abstehenden Rippen.*

3.4 Millimeter.

Negros: Dumaguete.

Lokalrasse: *F. impatiens-brunneus.* Kleiner an Gestalt, hellere braune Allgemeinfärbung. Die Posthumeralbinde verschwommener.

2.8 Millimeter.

Negros: Cuernos Mountains (*Baker*).

FORMICOMUS PACIFICUS sp. nov.

Oberkörper rotbraun, Flügeldecken etwas dunkler mit rötlichgelber, den Seitenrand nicht erreichender Posthumeralbinde. Kopf elyptisch, wenig länger als breit, Basis kurz. Glänzend. Kopf zerstreut, nur vorne etwas dichter, Halsschild an der Scheibe fein, gegen die Basis gröber, nicht dicht punktiert. Flü-

geldecken fein, wenig tief, zerstreut punktiert. Ueberall mit gelblichen abstehenden Borstenhaaren spärlich bedeckt. Vorderschenkel des ♂ mit starken, leicht abgestutzten Zahne; Vordertibien des ♂ einfach, an der Wurzel mit lichtem Haarbüschel.

3–3.2 Millimeter.

Northern Luzon: Ilnos.

FORMICOMUS OBFUSCATUS sp. nov.

Glänzend. Kopf, Halsschild, Fühler und Beine dunkelbraunrot, Flügeldecken schwarz, mit roter, den Seitenrand nicht erreichender und manchmal auch an der Naht unterbrochener, schmaler Posthumeralbinde. Kopf etwa so lang als breit. Fein und zerstreut, an der Stirne gröber und eingestochener punktiert; unscheinbar, wirr behaart.—Halschild länger als breit, etwas schmaler als der Kopf, an den Seiten vor der Basis kräftig eingeschnürt. An der Scheibe fein und ziemlich dicht, vor dem Basalrande quer runzelig punktiert; mit feinen lichten Härchen dicht bekleidet. Flügeldecken an den Seiten um die Mitte mässig breiter. Basis zu den breit gerundeten Schulterecken leicht abfallend. Schildchen klein, dreieckig, punktiert. Omoplaten kaum erhoben. Posthumeraleindruck schwach angedeutet. Sehr zerstreut punktiert; aus jedem Punkte entspringt ein lichtgelbes, ganz oder halb aufrechtes längliches Borstenhaar. Beine kräftig, alle Schenkel stark verdickt. Vorderschenkel des ♂ zu einem starken, schmal abgestutzten zahne ausgezogen; Vordertibien des ♂ an der Unterseite vor der Spitze schwach geschwollen und sodann eingebuchtet.

3–3.5 Millimeter.

Zamboanga (XII) (*Böttcher*).

FORMICOMUS FUSCATUS sp. nov.

Schwarz, glänzend, dem *F. lucidus-coaequalis* Kr. sehr ähnlich, doch ist seine Behaarung weniger grob und etwas dichter. Auch beim *F. fuscatus* bilden die Haare eine Art Binde im seichten Posthumeraleindrucke. Seiteneindruck des Halsschildes breit; die Einschnürung des Halsschildes vor der Basis ist schwach und besteht eigentlich nur eine Verschmälerung des Halsschildes gegen die Basis zu. Der Dorn an der inneren Seite in der Mitte der Vorderschenkel des ♂ ist schwach ausgebildet.

3.4–3.6 Millimeter.

Luzon: Cabogao, Ripan.

FORMICOMUS TENELLULUS sp. nov.

Dem *F. fuscatus,* was die Gestaltung der Endsegmente anbelangt, sehr ähnlich, jedoch typisch verschieden.

Kleiner, schmächtiger, sehr glänzend; dunkelrotbraun, nur die Flügeldecken mit 2 gelblichen bindenartigen Makeln im Posthumeraleindrucke bei einem ♀; diese Makeln fehlen bei einem ♂, das übrigens eine viel dunklere Allgemeinfärbung aufweist, gänzlich; Tibien gedunkelt.—Ueberall sehr fein und sehr zerstreut punktiert und mit lichtgelben, zum Teile abstehenden kurzen Borstenhaaren sparsam bekleidet.—Vorderschenkel des ♂ zu einem spitzen Zahne ausgezogen; Vordertibien des ♂ leicht geschwungen, sonst einfach.

2.8 Millimeter.

N. Luzon: Kalinga, Lubuagan (3,000 Fuss I) (*Böttcher*).

FORMICOMUS ADULTUS sp. nov.

Grösser, schwarz, Kopf, Fühler und Schenkel mit einem rötlicehn Stich. Die Flügeldecken mit einer gelbbraunen schmalen, den Seitenrand nicht erreichenden Posthumeralbinde.—Kopf etwa so lang als breit, ziemlich gewölbt. Augen gross, vorstehend; Schläfen gleich hinter den Augen abnehmend zur breit gerundeten Basis Erhobene Leistchen vor den Fühlerwurzeln. Fein und sehr zerstreut, nur an der Stirne etwas dichter punktiert und mit kurzen, feinen, gelblichen Haaren spärlich bedeckt. Fühler kräftig, bis über die Schultern reichend, Endglied um die Hälfte länger als das zehnte.

Halschild länger als breit, fast sobreit als der Kopf; knapp vor der Basis kräftig eingeschnürt; Seiteneindruck breit, tief, stark nach vorwärts sich fortsetzend. Ziemlich grob, nicht tief und nicht dicht punktiert und spärlich mit feinen gelblichen Härchen und überdies mit einzelnen ganz abstehenden Haaren be kleidet. Flügeldecken in der Mitte doppelt so breit als der Halsschild; etwa doppelt so lang als breit. Basis zu den spitzen Schulterecken deutlich abfallend. Posthumeraleindruck angedeutet. Schildchen länglich-spitz. Nathstreifen schmal. Sehr fein und sehr zerstreut punktiert und mit gelblichen nicht ganz anliegenden Borstenhaaren sparsam bedeckt. Beine ausserordentlich kräftig. Vorderschenkel des ♂ zu einem kräftigen, abgestutzten und an der abgestutzten Kante dicht gezahnten Dorne ausgezogen. Vordertibien des ♂ an der Unterseite in der distalen Mitte stark geschwollen. Unterseite hell gelbbraun, glänzend, kaum punktiert und behaart.

3.7 Millimeter.

Negros: Cuernos Mountains (*Baker*).

FORMICOMUS CRISPULUS sp. nov.

Dunkelbraun, Kopf und Halsschild gewöhnlich lichter rötlichbraun, ebenso Fühler und Beine und eine breite, fast das ganze

erste Drittel der Flügeldecken einnehmende, undeutlich begrenzte Querbinde. Kopf so breit als lang. Augen gross, mässig vorstehend; Schläfen zur breit gerundeten Basis leicht convergierend. Zerstreut und fein punktiert; aus jedem Punkte entspringt ein fast anliegendes gelbliches Borstenhaar. Fühler schlank, die Schultern erreichend; alle Glieder, bis auf das zweite kürzere, fast von der gleichen Länge, nur das Endglied um die Hälfte länger als das zehnte, spitz. Halsschild vorne etwas schmaler als der Kopf; länger als breit; an den Seiten hinter der Mitte schwach eingeschnürt; Seiteneindruck nicht tief. Wie der Kopf punktiert und behaart. Flügeldecken doppelt so lang, als um die Mitte breit. Basis gerade; Schulterecken spitz; Posthumeraleindruck gerade, seicht; sehr fein und sehr zerstreut punktiert; aus jedem Punkte entspringt ein halb aufrechtes lichtgelbes Borstenhaar. Beine kräftig; Schenkel verdickt. Vorderschenkel des ♂ in der Mitte der Innenseite zu einem kräftigen spitzen zahne ausgezogen; Vordertibien des ♂ einfach.

3 Millimeter.

Mindoro: Mangarin (XI) (*Böttcher*).

FORMICOMUS PHILIPPINENSIS Pic.

Formicomus philippinensis Pic, Mél. exot. ent. fasc. 4 (1912) 11; Kr., Philip. Journ. Sci. 27 (1925) 527.

Auch von Böttcher in Mengen in Iligan (V) erbeutet. Alle diese Exemplare weisen eine mehr oder minder vollständige rotgelbe Posthumeralbinde auf.

Ich bringe nochmals die Zeichnung der Endsegmente, auch aus dem Grunde, weil das sichtbare Endsternit in der Mitte einen behaarten Fortsatz hat, der bei dem ersten untersuchten Exemplare fehlte.

FORMICOMUS LUCIDUS Kr.

Formicomus lucidus Kr., Philip. Journ. Sci. 27 (1925) 527, Taf. 3, fig. 6.

Eine weit verbreitete Art, die zahlreiche Lokalrassen aufweist. Ich bringe eine neue deutlichere Zeichnung der Endsegmente. Rassen:

Formicomus lucidus-coaequalis.

Von constanter auffallend kleinerer Gestalt und fast ganz schwarz gefärbt; es kommen aber auch Exemplare vor, deren Vorderkörper und deren Beine elnen dunkelroten Stich haben und einige weisen zwei undeutliche kleine rote Posthumeralmakeln auf. Die aus weissen Borstenhaaren bestehende Bahaarung tritt deutlicher hervor nud bildet in dem ziemlich ausgeprägten

Posthumeraleindruck eine Art Binde. Die nicht dichte Behaarung ist abstehend.

2.8 Millimeters.

Luzon: Mount Maquiling.

Mr. Baker hat an dem gleichen Fundorte auch echte *F. lucidus* erbeutet. Es lassen sich übrigens Uebergänge zwischen der typischen Form und der Lokalrasse feststellen.

Formicomus lucidus-pullatus.

Allgemeinfärbung schwarz, Kopf und Halsschild mit rotbraunen Stich; zwei undeutlich begrenzte rundliche Flecken an Stelle der rötlichgelben Posthumeralbinde. Glänzend. Ueberall sehr schwach und sehr zerstreut punktiert; nur an der Scheibe des Halsschildes oberhalb des Basalrandes etwas dichter; mit gelblichen, nicht anliegenden Borstenhaaren sparsam bekleidet. Endglied der Fühler um die Hälfte länger als das zehnte, sehr spitz. Vorderschenkel des ♂ in der Mitte an der Unterseite ausgezogen und in einen leicht abgestutzten Dorn endigend; Vordertibien des ♂ einfach.

3.2 Millimeter.

San Miguel (III), Pagsanjan (III) (*Böttcher*).

Formicomus lucidus-basinotatus.

Halsschild und Beine heller rotbraun. Postmedianbinde heller und breiter une dimmt fast das ganze erste Drittel der Flügeldekken ein.

3.1 Millimeter.

Northern Palawan: Binaluan (I). Masbate (VIII) (*Böttcher*).

Formicomus lucidus-assimilis.

Grössere Gestalt. Vordertibien des ♂ mehr geschwollen. Beim letzten sichtbaren Endsternit fehlt das Mittelzäpfchen.

3.5 Millimeter.

Catanduanes: Virac (III) (*Böttcher*).

FORMICOMUS PRAETOR Laf.

Formicomus præetor LAF., Monographie (1848) 92.

Auf den Philippinen kommt dieser ostindische *Formicomus* auch vor, jedoch ist die Färbung des Kopfes und des Halsschildes, sowie des ersten Drittels der Flügeldecken nicht rötlich, sondern constant schwarz und weisen höchstens einige Exemplare einen blutroten Stich an diesen Körperteilen auf. Ausser der aus weissen Haaren gebildeten Posthumeralbinde, ist auch die sonstige

(spärliche) Behaarung weiss. Die Endsegmente der philippinischen Tiere sind etwas verscheden von jenen der ostindischen typischen Form. Ich erblicke in den Philippinischen Tieren eine Lokalrasse die ich.

Formicomus praetor-promiscuus benenne.

2.7 Millimeter.

Manila (XI) (*Böttcher*), Montalban (III) (*Böttcher*). Negros: Dumaguete.

ANTHLEPHILUS INHUMERALIS Pic.

Anthlephilus inhumeralis Pic, Annal. Soc. ent. France 71 1902 (1903) 644.

Neue Fundorte: Luzon: Manila; Mount Banahao (IV); Montalban (III). N. Luzon: Kalinga, Lubuagan (3,500 Fuss I). Mindoro: Mangarin (XI).

TOMODERUS

TOMODERUS PROMISCUUS sp. nov.

Klein, sehr glänzend; Kopf und Halsschild gelbbraun (die Einschnürung des Halsschildes dunkler); Flügeldecken rötlichbraun, bei den Omoplaten und hinter der Mitte undeutlich gedunkelt; Fühler und Beine hellgelb.

Kopf quer. Augen gross, vorstehend; Schläfen sehr kurz. Fein und zerstreut punktiert. Mit lichten abstehenden Haaren spärlich bedeckt. Fühler kurz, drittes Glied länger als das vierte bis zehnte; sechtes bis zehntes Glied breiter und sehr quer; Endglied mehr als doppelt so lang als das zehnte, spitz; alle Glieder dicht licht behaart.

Halsschild um die Hälfte länger als der Kopf. Vorderlobus schmaler als der Kopf. Einschnürung breit und kräftig; Hinterlobus noch schmaler als der Vorderlobus. Schwach und zerstreut, nur in der Einschnürung dichter und gröber punktiert; mit abstehenden lichtgelben Haaren spärlich bedeckt.

Flügeldecken fast doppelt so lang als der Kopf mit dem Halsschilde, an der geraden Basis doppelt so breit als der Hinterlobus des Halsschildes. Schulterecken breit gerundet. Omoplaten mässig erhoben. Posthumeraleindruck angedeutet, Nahtstreifen in der zweiten Hälfte deutlich, breit. Dicht und ziemlich stark punktiert und mit weisslichen nicht anliegenden Haaren ziemlich dicht bekleidet. Beine schlank.

2 Millimeter.

Mindanao: Surigao (XI) (*Böttcher*).

TOMODERUS LONGITHORAX sp. nov.

Grösser, sehr glänzend, ganz dunkelrotbraun, nur die Fühler namentlich deren Endglieder- lichter gelbraun; auch die Beine etwas lichter.

Kopf quer leicht gewölbt. Augen klein, kaum vorstehend; Schläfen etwas länger und leicht convergierend zur geraden Basis. Fein und zerstreut punktiert und unscheinbar licht behaart. Fühler schlank, die Schultern erreichend, siebentes bis zehntes Glied quer; Endglied doppelt so lang als das zehnte spitz. Alle Glieder kräftig und ziemlich dicht behaart.

Halsschild fast doppelt so lang als der Kopf. Vorderlobus schmaler als der Kopf. Einschnürung kräftig, breit. Hinterlobus kurz, schmaler als der Vorderlobus. *In der Einschnürung mit einer deutlichen Mittelrinne.* Ausserordentlich fein und zerstreut punktiert; kaum behaart.

Flügeldecken ziemlich eiförmig, gewölbt; um die Hälfte länger als der Kopf mit dem Halsschilde. Basis zu den breit gerundeten Schulterecken leicht abfallend. Keine Schulterbeule. Kein Posthumeraleindruck. Nicht grob, ziemlich dicht, leicht gereiht punktiert; mit feinen lichtgelben Haaren dicht bedeckt. Beine ziemlich kräftig.

2.4 Millimeter.

Northern Luzon: Ilnos Mountains.

TOMODERUS RECONDITUS sp. nov.

Schlanker als die vorstehenden Arten mit *ganz fehlenden Schultern* (daher *ohne Unterflügel*); ganz rotbraun, die Fühler und die Beine hellgelb.

Kopf eiförmig, leicht gewölbt, glänzend. Augen klein; Schläfen länglich und zur geraden Basis bogig abnehmend. Fein und zerstreut punktiert und mit lichten, teiweise abstehenden Haaren spärlich bedeckt. Fühler sehr kräftig, bis zur Basis des Halsschildes reichend, alle Glieder mit weisslichen abstehenden Haaren dicht bekleidet; fünftes bis zehntes Glied breiter quer; Endglied um die Hälfte länger als das 10., nicht sehr spitz.

Halsschild um die Hälfte länger als der Kopf. Vorderlobus etwa so breit als der Kopf. Einschnürung mässig; Hinterlobus wenig schmaler als der Vorderlobus. Der vordere Teil fast unpunktiert, glänzend; die Einschnürung und der hintere Teil dichter und gröber punktiert, matter; mit zum Teile sehr langen, lichten, abstehenden Borstenhaaren nicht dicht bekleidet.

Flügeldecken eiförmig, leicht gewölbt. Kein Posthumeraleindruck. Nahtstreifen fast vollständig, erhöht. Ziemlich grob, nicht dicht punktiert und mit gelblichen, nicht anliegenden

Haaren reichlich bedeckt. Beine mässig kräftig; Schenkel leicht verdickt.

2.4 Millimeter.

N. Luzon: Nueva Vizcaya, Imugan (V) (*Böttcher*).

TOMODERUS PULLATUS sp. nov.

Klein, glänzend, schmutzigbraun, Fühler und Beine heller.

Kopf quer; Augen klein, mässig vorstehend; fein und zerstreut punktiert und mit weisslichen Haaren schwach bedeckt. Fühler schlank, die Basis der Flügeldecken erreichend; Glieder acht bis zehn quer; Endglied mehr als doppelt so lang als das zehnte, spitz.

Halsschild kaum ein und ein halb mal so lang als der Kopf; vorne faste so breit als der Kopf, hinten schmaler. Einschnürung tief und kurz. *Mit einem feinen tiefen Längseindrucke,* der vor dem Basalrande aufhört. Sehr zerstreut punktiert und schwach behaart.

Flügeldecken fast doppelt so lang als der Kopf mit dem Halsschilde. Basis leicht abfallend zu den ziemlich breit gerundeten Schulterecken. Omoplaten nicht erhoben. Kein Posthumeraleindruck. Nahtstreifen ziemlich breit, erhoben. Grob und dicht punktiert und mit feinen gelblichen Haaren spärlich bekleidet. Beine kräftig, Schenkel ziemlich verdickt, Mittel- und Hintertarsen lang.

1.9 Millimeter.

Luzon: Mount Maquiling.

ANTHICOMORPHUS

ANTHICOMORPHUS RUFUS Kr.

Anthicomorphus rufus Kr., Philip. Journ. Sci. 27 (1925) 531, Taf. 1, fig. 8.

Neuer Fundort: Insel Samar (*Baker*).

ANTHICOMORPHUS ATRONOTATUS Pic.

Anthicomorphus atronotatus Pic, Mél. exot. ent. 36 (1922) 18.

Es liegen mir ein ♂ und ein ♀, die Böttcher in Los Baños (IV) erbeutete, vor, auf welche Exemplare die Beschreibung Pic's gut passt. Die Flügeldecken sind im ersten Drittel und um die Mitte, hier bindenartig, gedunkelt. Die Fühler des ♂ sind kurz, das dritte bis zum zehnten. Gliede quer, das Endglied fast viermal mal so lang als das zehnte. Beim ♀ ist das Endglied der Fühler kürzer und spitzer.

ANTHICOMORPHUS BICOLORATUS sp. nov.

♀. Kopf, Halsschild und Beine rot, Flügeldecken bläulichschwarz, nur an der Basis gerötet. Fühlerglieder drei bis zehn und alle Tibien leicht gedunkelt.

Kopf leicht quer-elyptisch, ziemlich gewölbt; Basis breit gerundet; Augen gross, rund, vorstehend, leicht nach oben gerückt. Dicht und stark punktiert; mit sehr feinen, gelblichen, darunter auch einigen abstehenden Haaren bedeckt. Fühler lang, schlank, leicht gesägt; erstes Glied breit; sechstes bis zehntes Glied etwa, so lang als breit; Endglied fast doppelt so lang, als das zehnte spitz.

Halsschild etwas schmaler als der Kopf, und um die Hälfte länger als breit. Seiteneindruck breit, kräftig. Wie der Kopf punktiert und behaart.

Flügeldecken fast parallel, etwas mehr als doppelt so lang als breit. Basis gerade. Schulterecken kurz gerundet. Schulterbeule deutlich. Omoplaten erhoben. Posthumeraleindruck breit, gerade. Fein, regelmässig, nicht sehr dicht punktiert; mit gelblichen, leicht abfallenden Härchen ziemlich dicht bekleidet.

Beine schlank; Schenkel wenig verdickt. Unterseite rot.

3.5 Millimeter.

Basilan (*Baker*).

ANTHICOMORPHUS HIRTULUS sp. nov.

Ganz dunkelrotbraun, ziemlich glänzend.

Eine durch die sehr langen und sehr schlanken nicht gesägten Fühler, deren Endglied doppelt do lang, ist, als die vorletzten Glieder, sowie durch die runden, besonders stark vorstehenden Augen (die auch beim ♂ weit von einander stehen) ausgezeichnete Art. Kopf und Halsschild dicht, fein und tief, die Flügeldecken weniger dicht und tief punktiert. Die Flügeldecken mit feinen gelblichen nicht ganz anliegenden Haaren dicht, und überdies mit ebenso gelblichen, aber längeren und ganz abstehenden Haaren spärlich bekleidet. Omoplaten deutlich erhoben. Posthumeraleindruck sehr kräftig.

3.5 Millimeter.

Samar (*Baker*). Bulusan (*Böttcher*).

PSEUDOLEPTALEUS

PSEUDOLEPTALEUS BIFIDUS sp. nov.

Klein, sehr glänzend; Allgemeinfärbung dunkelbraun, die Fühlerglieder eins bis acht, die Tibien distal sowie die Tarsen hellrotbraun, die Posthumeralbinde rötlichgelb.

Kopf etwas breiter als lang, quer-elyptisch, gewölbt. Augen fast rund, vorstehend. Zerstreut, fein, aber tief punktiert und mit sehr feinen, teilweise abstehenden Haaren spärlich bedeckt; Fühler schlank, die Schultern erreichend; das neunte und

zehnte Glied quer, Endglied um die Hälfte länger als das zehnte, Alle Glieder licht, fein behaart.

Halsschild schmaler und um die Hälfte länger als der Kopf. Vorderlobus im ersten Drittel am breitesten, dann gegen die Einschnürung geradlienig abnehmend, stark erhoben; Hinterlobus schmaler und kurz, mit zwei kleinen Erhebungen vor dem Basalrande; zwischen letzterem und den zwei Erhebungen eine kurze eingedrückte Längslinie. Seiteneindruck breit und tief, mit zwei Reihen anliegender feiner Haare. Zerstreut und ziemlich grob punktiert und mit feinen gelblichen Haaren regelmässig und ziemlich dicht bekleidet.

Flügeldecken an der geraden Basis so breit als der Vorderlobus des Halsschildes; an den Seiten um die Mitte deutlich breiter, zu den gemeinsam gerundeten Spitzen stark verengt. Schulterecken spitz. Posthumeraleindruck deutlich. Schildchen klein, halbrund. Nahstreifen im letzten Drittel sichtbar, seitlich leicht eingedrückt. Wie der Halsschild punktiert und behaart. Die Haare stehen im ersten Drittel in der Mitte nach rechts und links gescheitelt.

Beine schlank, Schenkel leicht verdickt.

Unterseite lichtbraun. Hinterbrust grob und zerstreut, Sternite fein und dicht punktiert und dicht behaart.

2–2.2 Millimeter.

Mindanao: Tangkulan, Mumungan: Iligan (II) (*Böttcher*). Negros: Cuernos Mountains.

PSEUDOLEPTALEUS CAPILLATUS sp. nov.

Ganz dunkel-bis schwarz-braun, nur die Fühler und die Beine gelbrot (die Schenkel manchmal leicht gedunkelt); auf den Flügeldecken eine gelbe Posthumeralbinde und unterhalb der Mitte je eine bindenartige, gegen die Naht nach vorwärts gerichtete, die Naht selbst nicht erreichende gelbe Makel. Die gelben Binden sind mit einer silberhaarigen dichten Behaarung bedeckt; die vordere Behaarung steht gescheitelt (Die Zeichnung ähnelt sehr derjenigen unseres *Anthicus transversalis* Villa= *tenellus* Lafterté.).

Kopf langgestreckt und an den Seiten parallel. Die mässig vorstehenden Augen sehr nach vorne gerückt; Schläfen lang. Basis spitzbogig. Grob und sehr dicht, ineinanderfliessend punktiert. Mit sehr feinen weisslichen Haaren oberflächlich behaart. Fühler schlank, nicht bis zu den Schultern reichend, zweites Glied kaum kürzer als das dritte; neuntes und zehntes. Glied leicht quer; Endglied um die Hälfte länger als das zehnte, spitz.

Halsschild breiter als der Kopf und wenig länger als dieser; um die Mitte stark eingeschnürt und zur Basis gerade abfallend. Seiteneindruck sehr breit und tief. Wie der Kopf behaart und punktiert jedoch dichter und silberiger behaart.

Flügeldecken kaum um die Hälfte länger als der Kopf mit dem Halsschilde. Basis sehr gerade, Schulterecken ziemlich spitz; an den Seiten um die Mitte mässig breiter. Ziemlich flach mit seichtem Posthumeraleindrucke. Weniger grob und dicht punktiert als am Vorderkörper; dicht doppelt färbig behaart.

Beine schlank, Schenkel mässig verdickt.

2.8–3 Millimeter.

Manila (III) (*Böttcher*).

ANTHICUS

ANTHICUS SINUATIPES Pic.

Anthicus sinuatipes PIC, Annat. Mus Genova 20 (1899–01) 799.

Dieser, von Herrn M. Pic aus den Mentawei'Inseln beschriebene *Anthicus* wurde von Böttcher in Bulusan (X), in Surigao (IX) und in Dapa, Siargao (IX) erbeutet.

Ich bringe die Zeichnung dieser durch den besonderen Bau der Hintertibien des ♂ ausgezeichneten Art.

ANTHICUS MEDIONOTATUS Pic.

Anthicus medionotatus PIC, Le Natur. (1903) 56.

Es liegen mir drei Anthicus aus Manila (X) vor, auf welche die Beschreibung Pic's im Allgemeinen passt; jedoch haben alle diese drei Exemplare ausser der dunklen Medianbinde noch eine dunkle Anteapicalmakel.

Ich bringe auch die Zeichnung dieser Art.

ANTHICUS HIRTISETOSUS Mars.

Anthicus hirtisetosus MARS., Notes Leyd. Mus. (1884) 164.

Neue Fundorte dieser weit verbreiteten Art: Surigao; Binaluan (Northern Palawan, XI, XII, *Böttcher*). Negros: Cuernos Mountains (*Baker*).

ANTHCUS CRINITUS Laf.

Anthicus crinitus LAFERTÉ, Monographie (1848) 204.
Anthicus manilanus PIC, Ann. Soc. Ent. France (1902) 646.

Anthicus manilanus Pic ist, wie ich durch genaue Untersuchung, auch des Kopulationsorganes feststellte, synonim mit *A. crinitus* Laf. Böttcher erbeutete diesen *Anthicus* in Manila (III).

ANTHICUS PUMICATUS sp. nov.

Glänzend. Kopf und Halsschild fast schwarz, Flügeldecken rötlichbraun, die Basis schmal schwarz gesäumt; im letzten Drittel mit einer ziemlich breiten, den Seitenrand nicht erreichenden, schwarzen Quermakel. Fühler und Beine gelbbraun, die ersteren distal leicht gedunkelt; ebenso die Tibienwurzeln.

Kopf länglich-elyptish, ziemlich flach. Augen sehr gross und sehr vorstehend. Grob und zerstreut punktiert und mit kurzen abstehenden Borstenhaaren nicht dicht bekleidet. Fühler schlank, bis über die Schultern reichend; achtes bis zehntes Glied etwas verdickt und leicht quer, Endglied etwas länger als das zehnte, spitz.

Halsschild wenig länger als der Kopf, am Vorderlobus schmaler als dieser, an den Seiten um die Mitte scharf eingeschnürt; Hinterlobus noch schmaler als der Vorderlobus. Fein und namentlich in der Einschnürung dicht punktiert. Ebenso wie der Kopf, nur noch spärlicher behaart.

Flügeldecken ein und einhalb mal so lang als der Kopf mit dem Halsschilde. Basis sehr gerade. Schulterecken ziemlich spitz. An den Seiten hinter der Mitte mässig breiter. Eher flach. Schulterbeule deutlich. Posthumeraleindruck angedeutet. Sehr grob und sehr zerstreut, etwas reihenförmig punktiert und mit länglichen abstehenden, lichten Haaren ziemlich dicht bekleidet.

Beine schlank, Schenkel wenig verdickt. Unterseit dunkelrotbraun, zerstreut punktiert und mit gelblichen, fast anliegenden Haaren sparsam bedeckt.

2.7 Millimeter.

Mount Maquiling (*Baker*).

Auf den ersten Blick einem *Pseudoleptaleus* ähnlich. Doch glaube ich diesen *Anthicus* eher in die Gruppe X *Clavicomus* (Clavicolles Marseul's) einreihen zu sollen.

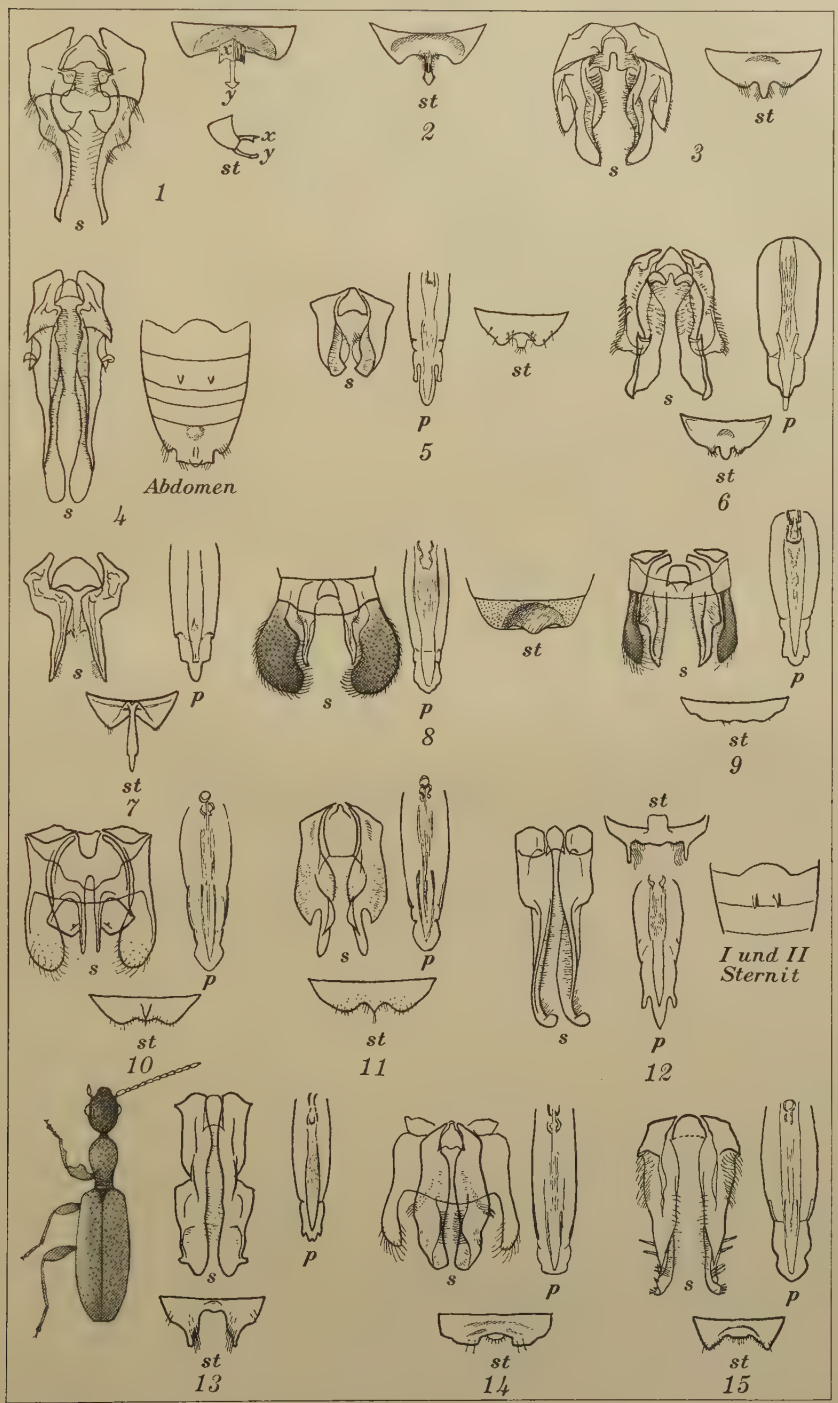
ILLUSTRATIONEN

Tafel 1

Fig. 1. *Formicomus ingens* sp. nov.
2. *Formicomus bispinosus* Kr.
3. *Formicomus böttcheri*, sp. nov.
4. *Formicomus consociatus* sp. nov.
5. *Formicomus excavatus* Kr.
6. *Formicomus bakeri* Kr.
7. *Formicomus hastatus* sp. nov.
8. *Formicomus simulans* sp. nov.
9. *Formicomus dibius* sp. nov.
10. *Formicomus confrater* nov.
11. *Formicomus abruptus* nov.
12. *Formicomus conspiciendus* sp. nov.
13. *Formicomus longithorax* Kr.
14. *Formicomus pumicatus* sp. nov.
15. *Formicomus rouyeri*, Pic.

Tafel 2

Fig. 1. *Formicomus foederatus* sp. nov.
2. *Formicomus lepidus* sp. nov.
3. *Formicomus braminus* Laferté.
4. *Formicomus protervus* sp. nov.
5. *Formicomus fraterculus* sp. nov.
6. *Formicomus affinis* sp. nov.
7. *Formicomus bardus* Pic.
8. *Formicomus obscurus* Pic.
9. *Formicomus javanus* Pic.
10. *Formicomus placidus* sp. nov.
11. *Formicomus impatiens* sp. nov.
12. *Formicomus pacificus* sp. nov.
13. *Formicomus obfuscatus* sp. nov.
14. *Formicomus fuscatus* sp. nov.
15. *Formicomus adultus* sp. nov.
16. *Formicomus crispulus* sp. nov.
17. *Formicomus philippinensis* Pic.
18. *Formicomus lucidus* Kr.
19. *Formicomus praetor* Laf.
20. *Formicomus praetor-promiscuus.*
21. *Tomoderus reconditus* sp. nov.
22. *Pseudoleptaleus bifidus* sp. nov.
23. *Pseudoleptaleus capillatus* sp. nov.
24. *Anthicus sinuatipes* Pic.
25. *Anthicus medionotatus* Pic.
26. *Anthicus pumicatus* sp. nov.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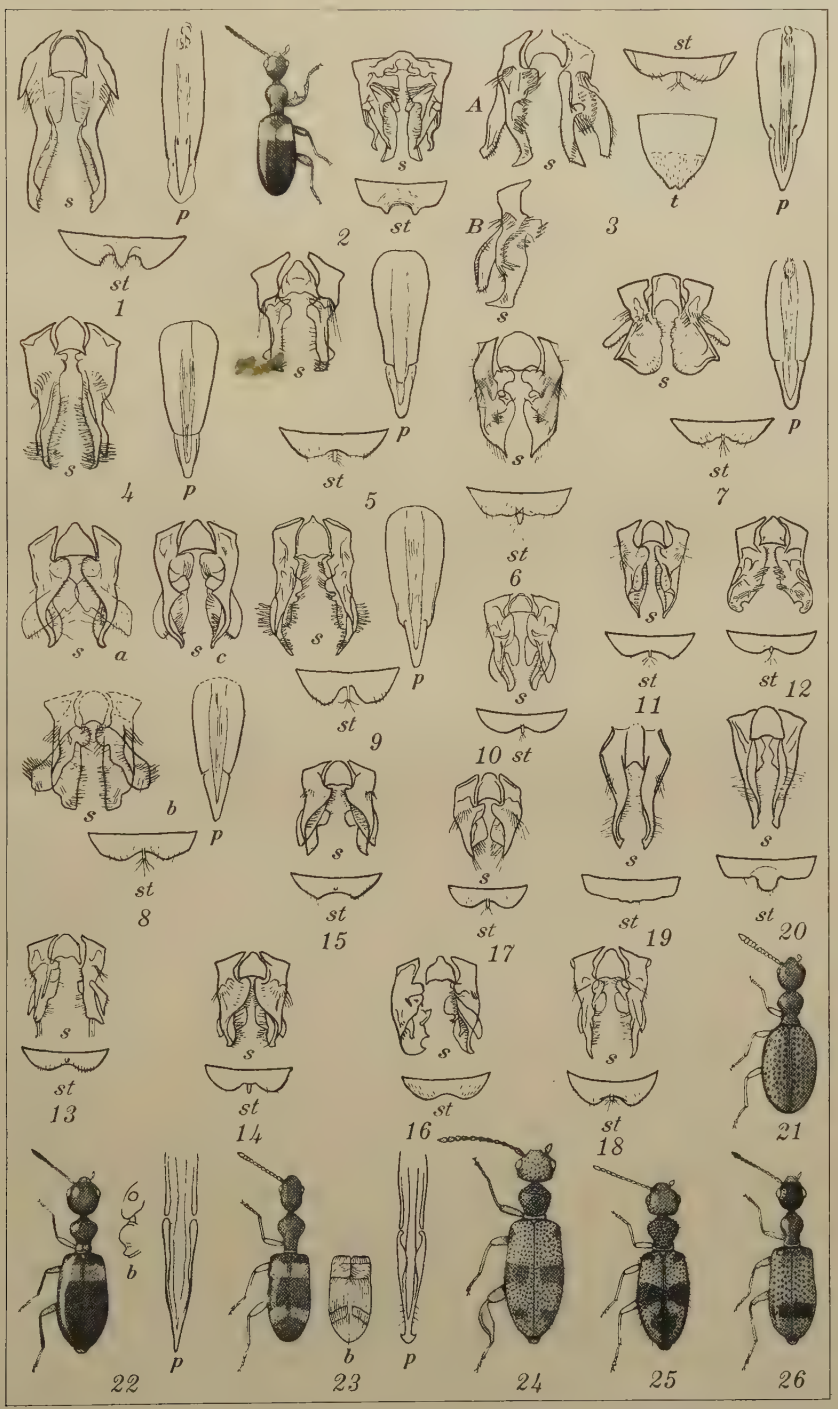
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TAFEL 2.

RESINS IN THE SEED COATS OF PHILIPPINE CHAULMOOGRA SEEDS (HYDNOCARPUS ALCALÆ)

By IRENE DE SANTOS and AUGUSTUS P. WEST

Of the Bureau of Science, Manila

ONE PLATE

The ethyl ester of chaulmoogric acid has been used in the treatment of leprosy. Chaulmoogric acid occurs in chaulmoogra, hydnocarpus, and lukrabo oils. The official chaulmoogra oil is obtained from the seeds of *Taraktogenos kurzii* King which is a tree indigenous to Burmah and Assam. The Philippine oil from *Hydnocarpus alcalæ* (Plate 1) contains a larger percentage of chaulmoogric acid than any of the other oils of the chaulmoogra group. The Philippine oil is obtained from seeds known locally as dudu-dudu.

The ordinary method of preparing Philippine chaulmoogra oil consists of removing the thin shells from the seeds, grinding the kernels, and extracting the pulp with ether, though the pulp could, of course, be hot pressed. As the kernels are covered with a dark skin, or seed coat (tegmen), the oil thus prepared has a yellow to a light brown color. Some experiments which we have carried out recently showed that if the brown seed coat (tegmen) is first removed from the kernels before extracting with ether the oil obtained is a white solid fat.

We thought it might perhaps be interesting to obtain some data on this white solid fat prepared from the Philippine seeds of *Hydnocarpus alcalæ* and also on the brown seed coat (tegmen) which was removed from the kernels of these seeds. Our results show that the white fat contains no resin acids while the seed coat contains 3.73 per cent of resin acids. Oil extracted from the seed coat also gave figures for the iodine number, free fatty acids, and unsaponifiable matter, which were slightly higher than the corresponding data obtained for the white fat. According to our experiments the resin acids of *Hydnocarpus alcalæ* seeds appear to be contained in the brown seed coat (tegmen) of the kernel and not in the kernel itself. If the seed coat is removed from the kernels before preparing the oil then the oil appears

to be free of resin acids and also of most of the yellow coloring matter contained in the seed coat.

Power,[1] who first worked out the formula for chaulmoogric acid, found that the true chaulmoogra oil (*Taraktogenos kurzii* King) contained resins. He had some difficulty in separating his pure compounds from these resins.

All the samples of Philippine chaulmoogra oil (*Hydnocarpus alcalæ*) which we have examined contained resins. Crude chaulmoogric acid separated from this oil contained small quantities of resin acids. Our usual method for separating chaulmoogric acid from the resin acids consists in treating the mixture with gasoline or petroleum ether which dissolve only the chaulmoogric acid.[2]

When used in the treatment of leprosy chaulmoogra oils sometimes have an irritating effect on the patient. This may be due to the resins contained in these oils.

The fruit of *Hydnocarpus alcalæ* is large and somewhat oval in shape, resembling to some extent a small unhusked coconut. It is about 20 centimeters in length and about 15 centimeters in width. Within the pericarp the seeds are embedded in the pulp and arranged in a rather circular manner. The seeds measure about 3 centimeters in length.

The Philippine oil (*Hydnocarpus alcalæ*) of the chaulmoogra oil group has been investigated by Brill [3] and also by Perkins and Cruz.[4] According to Brill the dried seeds of *Hydnocarpus alcalæ* contain 65.50 per cent of oil and the oil yields about 90 per cent of chaulmoogric acid. Since the acid content of this oil is unusually high it naturally serves as a good source of material for the preparation of chaulmoogric acid and its derivatives and also chaulmoogryl substituted compounds.[5]

EXPERIMENTAL PROCEDURE

The seeds of *Hydnocarpus alcalæ* used in this investigation were kindly presented to us by Dr. Nemesio Mendiola, of the

[1] Power, F. B., and F. H. Gornall, Journ. Chem. Soc. Trans. **85** 1 (1904) 838.

[2] Santiago, S., and A. P. West, Philip. Journ. Sci. **33** (1927) 266.

[3] Philip. Journ. Sci. **12** (1917) 37.

[4] Philip. Journ. Sci. **23** (1923) 543.

[5] Herrera-Batteke, P. P., and A. P. West, Philip. Journ. Sci. **31** (1926) 161; Santiago, S., and A. P. West, Philip. Journ. Sci. **33** (1927) 265, **35** (1928) 405; Santos, I. de, and A. P. West, Philip. Journ. Sci. **38** (1929) 293, **38** (1929) 445.

College of Agriculture, University of the Philippines. The thin shells were first removed from the seeds. The brown seed coat (tegmen) was very carefully removed in thin sections from the kernels by paring with a knife. The kernels were then ground to a pulp and extracted twice with ether. Each extraction lasted about two hours. The ethereal extract had a slight cream color due, perhaps, to the fact that all the seed coat was not entirely removed from the seeds. The warm extract was decolorized by treating with about 2 per cent of vegetable charcoal (suchar). Most of the suchar was then removed by filtering. In order to remove the last traces of suchar the warm ether extract was treated with about 1 per cent of talcum powder and filtered. The extract was then dehydrated with anhydrous sodium sulphate, filtered, and distilled to eliminate most of the ether. When the residue was evaporated a white solid fat was obtained. This was tested for oil constants such as saponification and iodine values and also for resin acids.

The brown seed coat (tegmen) which was removed from the seeds was ground to a pulp and heated (reflux) for about two hours with alcoholic potassium hydroxide. The mixture was filtered to eliminate the vegetable fiber. The clear solution was then acidified with dilute sulphuric acid and extracted with ether. The ether extract was dehydrated with sodium sulphate, filtered, and distilled to eliminate the ether. The last traces of ether were removed by placing the residue in an evaporating dish before an electric fan. The residue was then treated with petroleum ether and allowed to stand overnight. The petroleum ether precipitated the resin acids and dissolved the nonresinous material. Usually a portion of the resin acids adheres to the sides of the flask and is difficult to remove. The mixture was filtered and the filter paper returned to the flask in which the acids were precipitated. The resin acids were then dissolved in ether. The ethereal solution was dehydrated with sodium sulphate, filtered into a weighed flask, and the ether eliminated by distillation.

Another portion of the seed coat was ground to a pulp and extracted with ether. The ether extract was dehydrated with sodium sulphate, filtered, and the ether removed by distilling. The residue was then tested for common oil constants such as saponification and iodine values.

The results of our analysis of the ether extract of the kernels (*Hydnocarpus alcalæ*) from which the brown seed coat was

removed are given in Table 1. There are also included the analysis of the ether extract of the seed coat and the percentage of resin acids obtained from the seed coat. The table also contains analyses of *Hydnocarpus alcalæ* oil made by Brill and by Perkins and Cruz.

TABLE 1.—*Properties of the Philippine oil Hydnocarpus alcalæ.*[a]

	Sample.			
	A	B	C	D
Melting point °C	32			
Specific gravity $\frac{30° C}{4°}$	0.9502	0.948	0.9438	
Specific rotation (100 mm, 30° D)	+49.60	+48.3	+46.1	
Iodine value	93.10	94.0	84.1	89.9
Free fatty acids (as oleic)		6.7	0.25	0.57
Saponification value	188.9	202	197.6	197.9
Refractive index $N\frac{30° C}{D}$	1.4770	1.4763	1.4765	
Unsaponifiable matter			0.45	0.76
Resin acids			None	3.73

[a] Sample A analyzed by Brill; sample B analyzed by Perkins and Cruz; sample C the oil extracted from kernels (*Hydnocarpus alcalæ*) from which the brown seed coat was removed; sample D the oil extracted from the brown seed coat of the kernels.

Specific gravity of sample B determined at $d\frac{30°}{30°}$; iodine number for samples A and B determined by Hanus method and for samples C and D by Wijs.

As shown by the results (Table 1) when the seed coats were removed from the kernels (*Hydnocarpus alcalæ*) the kernels no longer contained any resin acids and had only a slight amount of coloring matter. The seed coats contained 3.73 per cent of resin acids and yielded a dark brown oil. These results indicate that the resin acids which are present in the oil of *Hydnocarpus alcalæ* are contained only in the seed coats of the kernels. Figures for the iodine value, free fatty acids, saponification value, and unsaponifiable matter are higher for the oil obtained from the seed coats than from the oil extracted from kernels without seed coats.

The authors wish to thank Dr. Nemesio Mendiola, of the College of Agriculture, University of the Philippines, who very kindly supplied the photographs for this paper.

SUMMARY

The oil obtained from the Philippine seeds of *Hydnocarpus alcalæ* has a brown color and contains a small amount of resin acids. The coloring matter and resin acids appear to be present

in the seed coats of the kernels of the seeds (*Hydnocarpus alcalæ*). Kernels with seed coats removed gave a white solid fat which contained no resin acids. Oil extracted from the seed coats which were removed from the kernels gave 3.73 per cent of resin acids and an oil of dark brown color.

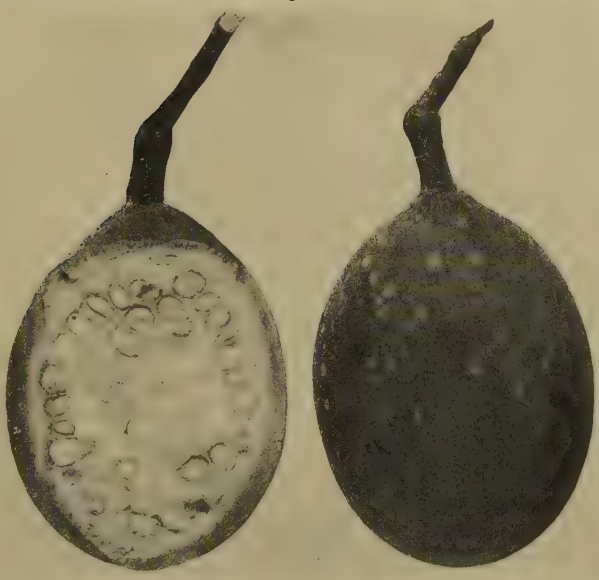
Figures for the iodine value, free fatty acids, saponification value, and unsaponifiable matter are higher for the oil obtained from the seed coats than for the oil extracted from kernels without seed coats.

ILLUSTRATION

PLATE 1

FIG. 1. *Hydnocarpus alcalæ* C. de Candolle, a tree in fruit.
2. *Hydnocarpus alcalæ;* fruit, entire and in longitudinal section.

1



2

PLATE 1. HYDNOCARPUS ALCALÆ.

CHAULMOOGRYL BROM AND CHLOR PHENOLS

By Pura Santillan

Of the University of the Philippines, Manila

and

Augustus P. West

Of the Bureau of Science, Manila

Various derivatives of chaulmoogric acid, such as esters and anilides, have been made from chaulmoogra oil. Recently the synthesis of some chaulmoogryl substituted phenols was completed.[1] This work has been continued, and in the present investigation a few chaulmoogryl halogen phenols were prepared. The method of preparation consisted in treating the acid chloride of chalmoogric acid with various halogen phenols. The results seem to indicate that these compounds may be prepared somewhat easily though the reactions take place rather slowly. The new compounds prepared in this research will be tested for their therapeutic value. In order to check the formulas of these compounds the halogen content was determined. A modified combustion method [2] for the determination of bromine in organic compounds was employed for making the halogen analyses.

EXPERIMENTAL PROCEDURE

The chaulmoogra oil used in this investigation was kindly presented to us by Dr. H. I. Cole, of the Philippine Bureau of Health, and was shipped directly to us from the Culion Leper Colony. The oil was prepared from the Philippine seeds of *Hydnocarpus alcalæ* C. de Candolle.

Since the chaulmoogric acid content of this Philippine oil is unusually high, it naturally serves as a good source of material for the preparation of chaulmoogric acid and its derivatives and also chaulmoogryl substituted compounds.[3]

[1] Santos, I. de, and A. P. West, Philip. Journ. Sci. 38 (1929) 293.

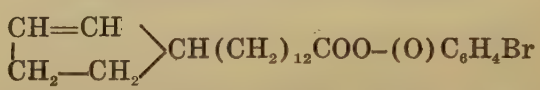
[2] Smith, F. L., Philip. Journ. Sci. 32 (1927) 315.

[3] Herrera-Batteke, P. P., and A. P. West, Philip. Journ. Sci. 31 (1926) 161; Santiago, S., and A. P. West, Philip. Journ. Sci. 33 (1927) 265, 35 (1928) 405. Santos, I. de, and A. P. West, Philip. Journ. Sci. 38 (1929) 293 and 445 and 40 (1929) 485.

The chaulmoogric acid and acid chloride of chaulmoogric acid were prepared according to the procedure used by Santiago and West.[4] Chaulmoogra oil (600 grams) was saponified with alcoholic potassium hydroxide (200 grams dissolved in 80 cubic centimeters of water and 800 cubic centimeters of aldehyde-free alcohol). The mixture was heated (reflux) on a water bath for about four hours, after which the excess alcohol was removed by distillation. The residual soaps were decomposed with dilute sulphuric acid (1 : 3) and the free acids extracted with ether. The ether extract was dehydrated with anhydrous sodium sulphate, after which the solution was distilled to eliminate the ether. The residue was treated with gasoline, and the precipitated resins were separated from the acid by filtering. The gasoline was then removed by distillation, and the residue was crystallized several times from alcohol (95 per cent). The melting point was 68° C.

The acid chloride of chaulmoogric acid was prepared by treating melted chaulmoogric acid with phosphorus trichloride. The reaction was finished in about fifteen minutes. The reaction product was filtered through glass wool to remove the viscous phosphorous acid, and the clear filtrate consisting of the acid chloride of chaulmoogric acid was allowed to drop slowly into the halogen phenol.

CHAULMOOGRYL O-BROM PHENOL



This compound was prepared by treating the acid chloride of chaulmoogric acid with *o*-brom phenol. Thirty grams of chaulmoogric acid were placed in a flask which was then immersed in hot water until the acid melted. The flask was then connected to a reflux condenser and 3.3 cubic centimeters of phosphorus trichloride were added slowly from a dropping funnel, and the mixture was warmed over a small flame. The reaction was finished in about fifteen minutes. Phosphorous acid separated at the bottom and side of the flask, while the acid chloride remained as a light supernatant liquid. In order to eliminate the phosphorous acid and other impurities the acid chloride was filtered through glass wool and the clear filtrate allowed to drop quickly into 16.1 grams of *o*-brom phenol. The mixture was heated (reflux) in an oil bath to a temperature of about

[4] Philip. Journ. Sci. 33 (1927) 265.

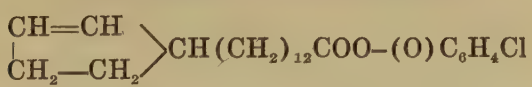
85° C. until the vapors of hydrochloric acid were completely eliminated. To prevent the access of atmospheric moisture, a tube containing calcium chloride was inserted into the top of the reflux condenser. After heating the mixture for about five days the reaction was practically completed. The reaction product was a black oily mass which solidified on cooling. This was dissolved in methyl alcohol and the solution treated with bone black to decolorize it, after which the mixture was filtered through a hot-water funnel. The crystals obtained from the filtrate were recrystallized several times from methyl alcohol containing animal charcoal. The compound thus obtained was a white, amorphous solid which gave a melting point of 51.5 to 53° C. The yield was about 20 per cent.

Solubility experiments show that the chaulmoogryl *o*-brom phenol is insoluble in acetic acid, acetic anhydride, ethyl alcohol, and nitro benzene. It was found to be slightly soluble in methyl benzoate, isopropyl alcohol, and ether, and very soluble in hot methyl alcohol.

Analysis:

	Bromine. Per cent.
Calculated for $C_{24}H_{35}O_2Br$	18.37
Found	18.41

CHAULMOOGRYL O-CHLOR PHENOL



The other chaulmoogryl brom and chlor phenols which were prepared were made in a manner similar to that used in the preparation of the chaulmoogryl *o*-brom phenol.

The acid chloride of chaulmoogric acid was prepared first by treating melted chaulmoogric acid (30 grams) with 3.3 cubic centimeters of phosphorus trichloride. The acid chloride thus obtained was filtered through glass wool and allowed to drop quickly into 12.5 grams of *o*-chlor phenol. The mixture was then heated in an oil bath at a temperature of 80° C. for about two weeks in order to complete the reaction. A black, solid, amorphous mass was obtained. The reaction product was crystallized several times from methyl alcohol containing animal charcoal. During the latter crystallization a yellow oil precipitated out of the alcoholic solution as a by-product. This was separated from the alcoholic solution by means of a hot separatory funnel. Experiments were made to convert this yellow

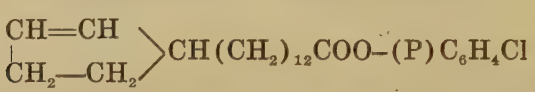
oil into crystals, but they were not successful. When purified, the chaulmoogryl *o*-chlor phenol was obtained as a white amorphous powder. The melting point was 48 to 50° C. The yield was about 25 per cent.

It was found to be insoluble in acetic acid, amyl alcohol, acetic anhydride, ethyl alcohol, ethyl benzoate, glycerin, and nitro benzene. It was slightly soluble in carbon bisulphide, ether, isobutyl alcohol, isopropyl alcohol, and methyl benzoate; it dissolved readily in cold petroleum ether and in hot methyl alcohol.

Analysis:

	Chlorine. Per cent.
Calculated for $C_{24}H_{35}O_2Cl$	9.09
Found	9.26

CHAULMOOGRYL P-CHLOR PHENOL



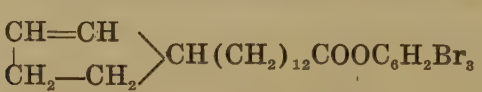
Chaulmoogric acid (30 grams) was melted and treated with 3.3 cubic centimeters of phosphorus trichloride. The acid chloride thus obtained was filtered and allowed to drop quickly into 10.5 cubic centimeters of *p*-chlor phenol. The mixture was heated in an oil bath (100° C.) for five days. The reaction product, which was a dark solid mass, was crystallized several times from petroleum ether containing animal charcoal. The white amorphous powder thus obtained has an oily appearance. When recrystallized from ethyl alcohol white crystals which melted at 53 to 55° C. were obtained. The yield was about 45 per cent.

Chaulmoogryl *p*-chlor phenol is slightly soluble in acetic acid, ethyl alcohol, gasoline, ethyl acetate, xylene, toluene, and absolute alcohol. It dissolves in hot petroleum ether but is more readily soluble in hot methyl alcohol.

Analysis:

	Chlorine. Per cent.
Calculated for $C_{24}H_{35}O_2Cl$	9.09
Found	9.14

CHAULMOOGRYL TRI-BROM PHENOL



The acid chloride of chaulmoogric acid, obtained by the interaction of melted chaulmoogric acid (30 grams) and phospho-

rus trichloride (3.3 cubic centimeters), was added quickly to 31 grams of tri-brom phenol (sym.). The mixture was heated (reflux) in an oil bath (80° C.) for about two weeks. The reaction product was a dark brown mass which was rather oily. It was crystallized several times from petroleum ether containing animal charcoal and afterwards from methyl alcohol. The alcohol seemed to remove the last traces of the oily material. When purified, the reaction product appeared to be a fine white powder which melted at 54 to 56° C. The yield was about 33 per cent.

It is very soluble in acetone, carbon tetrachloride, ethyl acetate, chloroform, methyl benzoate, toluene, hot methyl alcohol, and petroleum ether but only slightly soluble in absolute alcohol, cold methyl alcohol, and petroleum ether.

Analysis:

	Bromine. Per cent.
Calculated for $C_{24}H_{33}O_2Br_3$	40.44
Found	40.55

SUMMARY

Four new compounds were prepared in this investigation; namely, chaulmoogryl *o*-chlor phenol, chaulmoogryl *o*-brom phenol, chaulmoogryl *p*-chlor phenol, and chaulmoogryl tri-brom phenol.

Chaulmoogryl *o*-brom phenol was prepared by treating the acid chloride of chaulmoogric acid with *o*-brom phenol. Chaulmoogryl *o*-chlor phenol was made by the interaction of *o*-chlor phenol and the acid chloride of chaulmoogric acid. By treating *p*-chlor phenol with the acid chloride of chaulmoogric acid there was obtained chaulmoogryl *p*-chlor phenol. Chaulmoogryl tri-brom phenol was prepared by treating the acid chloride of chaulmoogric acid with tri-brom phenol.

Our results indicate that these esters may be made rather easily but the reactions take place very slowly.

THE CONSTITUENTS OF HYDNOCARPUS WIGHTIANA OIL, I [1]

By Howard Irving Cole

Chief Chemist, Culion Leper Colony, Philippine Health Service

The main constituents of *Hydnocarpus wightiana* oil are the glyceryl esters of hydnocarpic and chaulmoogric acids. The actual amounts of each of these present in the oil have been only roughly estimated.[2] The complete separation of one acid from the other is attended with difficulties.[3] The partial separation of these two constituents may be accomplished by the fractional distillation of their ethyl esters at low pressures.

In this distillation, a low-boiling fraction is obtained which exhibits optical activity. Power and Barrowcliff,[4] working with the fatty acids from *H. wightiana* oil, state that the mother liquor from which the hydnocarpic and chaulmoogric acids have been crystallized would appear to consist of chaulmoogric and hydnocarpic acids together with a still lower homologue of the same series having the formula $C_{14}H_{24}O_2$. In the fractional distillation of the ethyl esters from *H. wightiana* oil at 20 millimeters, Perkins [5] found no evidence of any appreciable quantity of a C_{14} acid, but did find that there was a definite concentration at 160 to 165° C.

ISOLATION OF LAURIC ACID

In an attempt to isolate the lower homologue of hydnocarpic acid referred to, 1 liter of the fraction boiling below 200° C. at 20 millimeters (obtained from about 50 liters of *H. wightiana* ethyl esters), was refractionated several times. The results of the fifth fractionation are shown in Table 1.

[1] Published with the approval of the Director of Health on recommendation of the Philippine Leprosy Research Board.

[2] Perkins, G. A., Journ. Ind. Eng. Chem. 19 (1927) 941.

[3] The large-scale isolation of both acids from *H. wightiana* oil will form the subject of another paper.

[4] Journ. Chem. Soc. 87 (1905) 884.

[5] Journ. Ind. Eng. Chem. 19 (1927) 941.

TABLE 1.—*Fifth fractionation of low-boiling substances in ethyl esters of H. wightiana oil.*

Fraction No.	Degrees C. corrected.	Quantity collected.	Refractive index ^{n} D.	Optical activity ^{a} D.
	°C.	cc.		°
1	151–153	95	1.4334	+ 9.0
2	153–155	105	1.4314	+10.0
3	155–157	325	1.4324	+13.5
4	157–159	240	1.4314	+18.5
5	159–161	120	1.4356	+24.3
6	161–163	25	1.4397	+27.1

Eighty grams of fraction 3 were saponified with alcoholic potassium hydroxide and the acid liberated with hydrochloric acid. The melting point of this acid fraction was 37.7° C. It was recrystallized from two volumes of 80 per cent alcohol five times. The crystals were collected on a filter paper, pressed dry, washed several times with hot water, and dried. The melting point of the acids so obtained are shown in Table 2.

TABLE 2.—*Recrystallization of fatty acid from H. wightiana oil.*

Crystallization.	Melting point. °C.
1	39.8
2	43.0
3	43.3
4	43.6
5	43.6

Fractions 4 and 5 crystallized as pure substances do, and proved upon analysis to be lauric acid.

Analysis of substance: 0.2000 gram, 10.0 cubic centimeters of 0.10015 *N* NaOH. Calculated for $C_{21}H_{21}O_2$ equivalent weight, 200; found 200. Melting point lauric acid, 43.6° C.; melting point substance, 43.6° C. Optical rotation and iodine number zero.

In order to obtain some idea of the amount of lauric acid present in *H. wightiana* oil, 2 kilograms of oil were esterified, the esters were washed and dried and then fractionally distilled five times at 20 millimeters. The fraction boiling below 200° C. amounted to 108 grams. This yielded 100 grams of free fatty acids. The lauric acid obtained from this mixture was 24 grams (1.2 per cent).

SEPARATION OF AN OPTICALLY ACTIVE FATTY ACID

The mother liquors from the lauric acid crystallizations were combined. Twitchell's method [6] was used to remove the remaining lauric acid. A residue of 43 grams of liquid fatty acids was obtained and gave an iodine number of 45.6, a neutrality equivalent of 239, and an optical rotation of +24.0°. This liquid was distilled at 20 millimeters, in 10-degree fractions.

TABLE 3.—*Distillation of liquid fatty acids at 20 millimeters.*

Fraction No.	Quantity.	Temperature °C. corrected.	Optical activity.
	g.	°C.	°
1	8	150–160	+24.0
2	5	160–170	----------
3	15	170–178	----------
4	10	178–185	+30.2

The odors of fractions 1, 2, and 3 indicated that they were contaminated with esters formed during the extraction of the lauric acid by Twitchell's method. These fractions were esterified and distilled at 20 millimeters, passing over between 137 to 152° C. Fraction 4 was obviously still a mixture of acids. It gave an iodine number of 53.8 and a neutrality equivalent of 201.

Fraction 4 was further purified by dissolving it in 95 per cent alcohol and fractionally precipitating the solid fatty acids still remaining in solution by adding small quantities (1 gram) of barium acetate dissolved in the smallest amount of hot water possible. Five precipitations were necessary. The liquid acids remaining in the alcoholic solution were separated by adding hot water, washed several times with water, dried, and distilled at 20 millimeters. Two fractions boiling between 160 and 175° C. and between 175 and 185° C. were obtained. The lower-boiling fraction probably contains some esters. The constants given in Table 4 indicate that fraction 2 contains at least two acids,

TABLE 4.—*Liquid acids from H. wightiana oil.*

Fraction No.	Neutrality equivalent.	Iodine number.	Optical activity.	Refractive index.
			°	
1	244	55.8	21.8	1.4444
2	213	67.2	36.1	1.4504

[6] Journ. Ind. Eng. Chem. 13 (1921) 806.

one of which is saturated and the other unsaturated, exhibiting optical activity. From these results it seems likely that the unsaturated acid when isolated will prove to be a lower homologue of hydnocarpic acid (exhibiting optical activity), and that the saturated acid will prove to be unremoved lauric acid, as the progressive purification of the liquid acids raised the iodine number, neutrality equivalent, and optical activity. This hypothesis would account for the low iodine number and the neutrality equivalent of 213 in fraction 2.

SUMMARY

1. Lauric acid has been isolated from *Hydnocarpus wightiana* oil for the first time.

2. A new, optically active, liquid fatty acid has been obtained from *H. wightiana* oil, but not in sufficient purity to determine its composition. It is probably a lower homologue of hydnocarpic acid.

REDUCTION OF IRRITATION BY IODIZED ETHYL ESTERS OF HYDNOCARPUS WIGHTIANA OIL [1]

By Howard Irving Cole

Chief Chemist, Culion Leper Colony, Philippine Health Service

TWO PLATES

Ten years ago the injection of crude chaulmoogra oil in the treatment of leprosy was greatly restricted because of its irritant properties. To-day, some workers use refined oils of the chaulmoogra group. Such an oil, from *Hydnocarpus wightiana,* is used here at Culion for some purposes, though not as the main antileprosy drug. This oil is practically non-irritating, but its virtue is in no way reduced; if anything, it is more efficacious than the crude product. However, in certain places, presumably because of the old belief that it is more effective, the crude chaulmoogra oil is still used, as by Johansen [2] who mixes benzocaine with it to alleviate the pain.

While the refined chaulmoogra and *wightiana* oils as made and administered at Culion [3] leave little to be desired in the way of improvement, the fact remains that they are not as effective as the ethyl esters. However, the ethyl esters even when highly purified are undesirably irritating. If a small amount of iodine is added the irritant effects are very markedly reduced, so much so that the iodized ethyl esters are used now on the great majority of the patients at Culion with no untoward effects and very low complaint rates.

Reports from other leprosariums indicate that where the ethyl esters are used, they are much more irritating than those manufactured here. This is of considerable importance, for it is apparently due to this fact that the ethyl esters have not been given the place in leprosy therapeutics that years of experience in the Philippines show they should have, and that where they are used less satisfactory results are obtained. A standard method of manufacture is evidently much to be desired.

[1] Published with the approval of the Director of Health on recommendation of the Philippine Leprosy Research Board.

[2] U. S. Pub. Health Service, Reprint No. 1193 (1927).

[3] Perkins, G. A., Journ. Ind. Eng. Chem. 19 (1927) 939.

A method for the preparation of iodized ethyl esters of low-irritating character is included in this paper.

REDUCTION OF IRRITANT QUALITY BY IODINE

Iodine (2 per cent) was originally added to the esters with the idea that it might serve as a curative agent.[4] After the collapse of this expectation [5] it was still retained [6] because it was found that it reduced considerably the irritation produced by injection. Addition of iodine to the refined oil for this purpose is not necessary, and it is not feasible as it thickens the oil to such an extent as to make the injection extremely difficult.

For several years we have been adding 0.5 per cent iodine instead of 2 per cent to the ethyl esters at it was found to be preferable in several respects.[7] Recent experiments have shown that reduction of iodine content to less than 0.5 per cent led to increase in irritant properties.

Not only is the amount of iodine important but the time and temperature of heating to combine it with the esters has been found to exert a considerable influence on its ability to reduce irritation. Heating for too long a time or to too high a temperature is to be avoided as it leads to the production of irritating decomposition substances. Too short a period of heating or too low a temperature gives a turbid greenish product which is also irritating. It has recently been found that to heat the mixture until it appears brown, without reference to time, is not satisfactory, for the color change does not afford a sharp end point.

Irritation may, however, be caused by other factors, such as impurities, decomposition products formed on heating or chemical treatment, free fatty acids, and the compound itself.

Impurities in the ethyl esters that might cause irritation are largely eliminated in the mode of preparation described below. It has been shown [8] recently that even chemically pure ethyl chaulmoograte and ethyl hydnocarpate with 0.5 per cent iodine cause as much irritation as the iodized mixed esters. This indicates that irritation by the mixed ethyl esters without a modifying

[4] McDonald, Reprint from U. S. Public Health Reports 35, No. 34 (1920).
[5] McDonald and Dean, Journ. Am. Med. Assoc. 76 (1921) 1470.
[6] Hasseltine, U. S. Public Health Bull. 141 (1924) 8.
[7] Wade, H. W., Philip. Journ. Sci. 25 (1924) 710.
[8] Vera, B. de, and C. B. Lara, Journ. Philip. Islands Med. Assoc. in press.

additive such as iodine does not necessarily imply the presence of impurities.

Decomposition products are formed upon heating or chemical treatment but these can be largely blown out with steam.

Free fatty acids are almost entirely eliminated by careful neutralization with sodium hydroxide and by very thorough washing. The maximum free fatty acid content (estimated as oleic acid) that we now allow is 0.2 per cent, but our product seldom contains over 0.1 per cent.

The inherent irritation due to the configuration of the compound is, of course, not removable without changing the compound itself. Although the iodine combines with the ester molecule by elimination of the double bond in the pentene ring, the actual amount present is sufficient to saturate only about 0.5 per cent of the molecules. If the reduction of irritation were due to this saturation, we would expect the reduction to be very slight, while as a matter of fact, it is very marked. Furthermore, 2 per cent iodine does not reduce the irritation to any greater extent than does 0.5 per cent. It has been thought in the past that there might be present in the esters a very small amount of highly irritating impurities with which the iodine tends especially to combine, but it is not certain that such impurities are present for especially purified products retain their irritant quality. A satisfactory explanation of the cause of the reduction of irritation by the addition of iodine is yet to be given.

We cannot expect to secure much further reduction in irritating properties in the ethyl esters by further lowering of free fatty acid content, since that is now as low as it is practicable to make it, or from further elimination of impurities since, as has been said, it has been shown that mixed esters are at present no more irritating than the chemically pure ethyl hydnocarpate itself. There remain then the possibilities (1) of reducing the amount of decomposition products either by less strenuous treatment in the preparation of the esters or by longer blowing out with steam and (2) of so adjusting the time-temperature factor, after adding iodine, as to secure the maximum reduction of the inherent irritant quality and to avoid secondary production of decomposition products.

To use less strenous treatment in the preparation of the esters than we do at present is impracticable. Increasing the time

of blowing out with steam beyond two hours leads to no improved results.

Until recently, our method of heating with iodine was "to heat at 150° C. to a brown color."[9] It is difficult to reproduce this color exactly by eye alone. Consequently, if this criterion is used, various lots may differ in the time of heating. It has been our experience that from time to time the esters with 0.5 per cent iodine have been markedly more irritant than usual, and the cause was finally determined to be variations in the time of heating to obtain this color end point. Therefore, a series of experiments was made to show the relation of time and temperature of heating to the amount of irritation produced on injection.

Ten liters of dry purified mixed ethyl esters of *H. wightiana* oil were heated in an open kettle to 140° C.; this took 30 minutes. Fifty grams of iodine (Mallinckrodt, U. S. P. resubl.) were added with stirring. The temperature immediately rose and was maintained at 150° C. A two-liter sample was dipped out 15 minutes after the iodine was added, another 15 minutes later and so on until five samples were obtained, representing 15, 30, 45, 60, and 75 minutes heating with iodine at 150° C. The samples were then cooled, filtered into 250-cubic centimeter bottles, and sterilized in a hot-air oven for one hour at 150° C. In this time the actual temperature of the liquid in the bottles reached only 110° C. These lots were labeled 1, 2, 3, 4, 5. Five groups of approximately 300 lepers each were injected once with the different lots by the medical staff.

TABLE 1.—*Irritation produced by ethyl esters of Hydnocarpus wightiana oil with 0.5 per cent iodine.*[a]

Lot No.	Time of heating with iodine at 150° C.	Number of patients.	Immediate complaints.		Late complaints.				
			Number of patients.	Per cent.	Number of patients.	Induration.		General.	
						Number.	Per cent.	Number.	Per cent.
	Min.								
1	15	332	101	30.4	325	39	12.0	55	17.0
2	30	298	46	15.4	325	35	10.8	26	8.0
3	45	320	39	12.2	308	19	6.2	32	10.4
4	60	323	44	13.6	330	25	7.5	23	7.0
5	75	283	74	26.2	346	37	10.7	70	20.2

[a] These data were kindly furnished by the medical section, Dr. C. B. Lara, chief physician in charge. Five cubic centimeters were injected in each patient by the Plancha method.

[9] Perkins, G. A., Philip. Journ. Sci. 24 (1924) 630.

It is seen from Table 1 that too short as well as too long a heating leads to markedly greater irritation. In the former case, it is obviously due to uncombined iodine; in the latter, it is probably due to formation of decomposition products. These lots were used within a day after being prepared and at that time showed a gradation of color and clarity from a turbid brownish green in No. 1 to a pure clear brown in No. 5. At the end of two weeks, however, lots 2, 3, 4, and 5 were all of the same clear brown color. Lot 1 was still a turbid brownish green at the end of two months. This would indicate that the reaction between the iodine and the esters goes to completion in from sixty to seventy-five minutes at 150° C., but that, on the other hand, it takes two weeks to go to completion at room temperature (30° C. maximum) when heated with the iodine for only thirty minutes at 150° C. In view of the above facts, heating at a temperature lower than 150° C. is not considered feasible.

Since the reaction went to completion even at room temperature in lots 2 and 3 in two weeks time, 10 liters of each of these were again made up and stored for two weeks before being used. The results of treating 3,000 cases with these two lots indicated that lot 2 was as nonirritating as lot 3. It was therefore decided that for routine production the mixture should be heated at 150° C. for only thirty minutes and stored for two weeks before using, thus securing the maximum effect of the iodine with the least opportunity for the formation of decomposition products.

PRESENT METHOD OF MANUFACTURE OF MIXED ETHYL ESTERS OF CHAULMOOGRA-GROUP OILS

Esterification.—The esterification is conducted as described by Perkins [10] but is included here for the sake of completeness. Ten liters of *H. wightiana* oil are boiled vigorously for forty-eight hours with 5 liters of 95.5 per cent ethyl alcohol and 100 mils of concentrated sulphuric acid. The principal advantage of vigorous boiling is undoubtedly that it keeps the two layers well mixed. In our plant the boiling is done in stoneware acid carboys of 26-liter capacity set in concrete tubs which serve as steam jackets. The alcohol vapor is condensed by a reflux condenser made of 13-millimeter brass pipe, 1.5 meters long with water jackets of 38-millimeter galvanized iron pipe soldered on (Plate 1). The contents of the carboy are washed three times

[10] Philip. Journ. Sci. 24 (1924) 627.

with about 20 liters of water and then dried in a steam kettle. The yield from 10 liters of oil is about 11 liters of esters. If desired the first washing may be neutralized with lime and fractionally distilled to recover the alcohol.

Distillation.—The washed and dried ethyl esters are then distilled at 20 to 25 millimeters pressure. The still used in our laboratory is made by welding a cap on one end of a piece of 15-centimeter iron pipe, 30 centimeters long, and a 15 by 5 centimeter reducing coupling on the other end. Into this coupling is screwed a still head of extra heavy iron pipe with a vacuum connection at a T (Plate 2). A wrapping of twenty-five turns of No. 22 chromel A wire around the still head is used for auxiliary electric heating (110 volts). Loosely fitting asbestocel pipe covering forms a hot-air bath for the still and still head throughout its entire length. Heating is done by means of a large kerosene burner (Manning No. 6) as gas is not available. After about 30 liters have been distilled, the residue while hot is removed through a hole near the bottom of the still. After a month of continuous use the still head is unscrewed, the body and head are heated in a fire until the spongy residue becomes brittle, and the contents are scraped out.

Washing with alkali.—Five hundred grams of lye (94 per cent sodium hydroxide) are dissolved in 80 liters of hot water 90° C.) in a 160-liter steel drum. Forty-five liters of the distilled ethyl esters (2.5 to 3 per cent acidity) are thoroughly mixed in. After the mixture has stood for twenty-four hours the clear lower layer is drawn off through an outlet in the bottom of the tank. Hot water (90° C.) is added to the 140-liter mark, thoroughly mixed in, allowed to settle for twenty-four hours, and again drawn off. The washing with water is repeated thus four times with twenty-four hours settling each time. The yield is about 96 per cent and the acidity (as oleic acid) is usually under 0.1 per cent. About 15 liters of the washed esters are put in a 26-liter stoneware carboy and steam is passed through it for two hours or longer until the sharp odor produced by heating has disappeared. The esters are placed in ordinary 5-gallon oil tins to settle and then poured off from the separated water and filtered through paper. The product is a clear, very pale yellow, mobile liquid with a slight characteristic odor.

Addition of iodine.—Fifteen liters of the purified esters are heated in a 20-liter enameled kettle to 140° C. They must be

thoroughly dried.[11] Seven and five-tenths grams of U. S. P. resublimed iodine is added with stirring. The temperature immediately rises to 150° C. at which point it is maintained for thirty minutes and is stirred occasionally. After cooling, the iodized esters are filtered into bottles (250 cubic centimeters capacity) and sterilized for one hour in an oven at 150° C. The temperature of the contents of the bottles reaches in this time 110° C. The bottles are corked and sealed with paraffin or sealing wax and allowed to stand two weeks before using. A time limit of two years is set on the use of the esters although samples which have stood longer than three years do not seem to have deteriorated sufficiently to become markedly irritating.

SUMMARY

1. The factors governing irritation by iodized ethyl esters of *Hydnocarpus wightiana* oil are discussed.

2. Experiments show that too long as well as too short a time of heating of the esters with iodine leads to increase in irritant properties.

3. A method for the manufacture of iodized ethyl esters that reduces irritant properties to a minimum is described.

4. A more accurate control of the heating with iodine by means of a time-temperature factor eliminates the occasional increase in irritant properties of the iodized esters due to the inaccuracy of a color end point.

[11] "The esters must be thoroughly dried before iodine is added since the latter effects by catalysis the hydrolysis of several per cent of the esters if water is present."—Perkins, G. A., Philip. Journ. Sci. 24 (1924) 630. If the filtered esters are clear, the heating to 140° C. before adding the iodine will drive off all the dissolved water.

ILLUSTRATIONS

Views of the leprosy drug plant at Culion Leper Colony. (Photographs by Merl LaVoy.)

PLATE 1

A portion of the chemical plant showing the concrete steam tubs and metal condensers used for the esterification of *Hydnocarpus wightiana* oil.

PLATE 2

A portion of the chemical plant showing a near view of the vacuum still and the bottling of the iodized ethyl esters of *Hydnocarpus wightiana* oil.

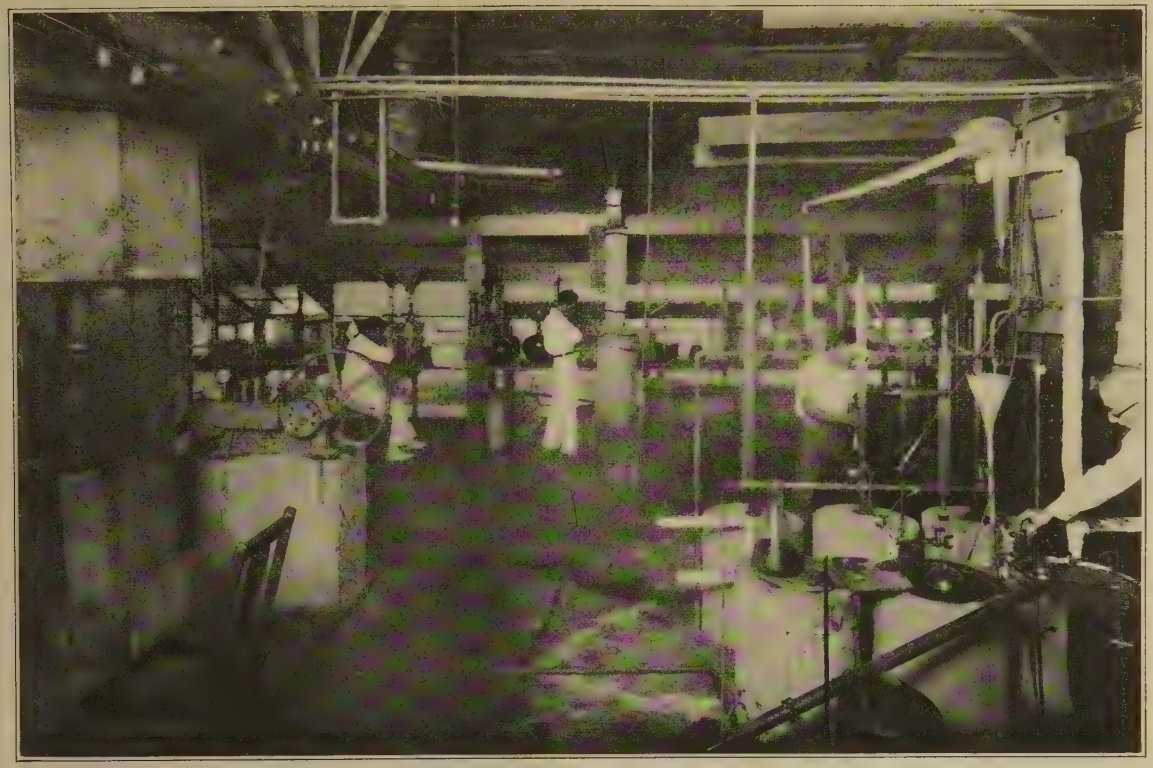


PLATE 1. CONCRETE STEAM TUBS AND METAL CONDENSERS.

PLATE 2. THE VACUUM STILL AND BOTTLING TABLES.

SEGUIDILLAS BEAN

By F. Agcaoili

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Many analyses of several varieties of beans are to be found in the literature. Some of these beans are valued more or less because of their nitrogenous elements and others because of their carbohydrate content. The bean of *Psophocarpus tetragonolobus* (Linnæus) de Candolle is known in Tagalog as "seguidillas" or "calamismis," in Ilocano as "pal-lang," and in English as the "asparagus bean." This paper shows the food value of the dried seed of seguidillas as compared with that of soya bean.

The botanical description of the plant follows:[1]

A glabrous, twining, annual vine reaching a length of 6 m or more. Leaves 3-foliolate, leaflets ovate, entire, acuminate, 8 to 14 cm long, base deltoid. Racemes few-flowered up to 15 cm in length. Flowers light-blue, 3 to 3.5 cm long. Pod square, 10 to 20 cm long, about 2 cm thick, 4-winged, the wings about 5 mm wide, crisped. (Fl. Filip, *pl. 293*.)

Commonly cultivated for its edible pods, occasionally spontaneous, fl. Oct.–Dec., certainly introduced. India and Malaya.

The bean, or seed, is edible when cooked and has a skin similar to that of the soya bean. The skin constitutes 12 per cent and the kernel 88 per cent, by weight, of the bean.

The dry bean is brown and is slightly veined with dark brown streaks. It is rounded and laterally compressed, and is about 10 millimeters in length, 8 millimeters in width, and 7 millimeters in thickness. The hilum which is situated at the lateral side is 4 millimeters long and 2.5 millimeters wide. The skin is smooth and shiny.

Table 1 shows the results of the analysis of the whole seeds in comparison with the corresponding figures for soya bean.

The oil was extracted from the crushed seeds with ether, and analyzed. The results are shown in Table 2, which includes for comparison the figures for soya-bean oil.

The seed when tested for prussic acid gave a negative result.

[1] Merrill, E. D., A Flora of Manila, Bur. Sci. Publ. 2 (1912) 264.

TABLE 1.—*Analysis of seguidillas and soya beans.*

Constituent.	Seguidillas.	Soya bean.[a]
	Per cent.	*Per cent.*
Moisture	9.74	9.84
Fat	17.04	18.97
Protein (N×6.25)	32.81	37.53
Starch	12.50	----------
Carbohydrates other then starch, by difference	18.70	----------
Ash	4.01	4.79
Crude fiber	5.20	----------

[a] Philip. Journ. Sci. § A 7 (1912) 48.

TABLE 2.—*Analysis of sguidillas and soya-bean oils.*

	Seguidillas.	Soya bean.
Refractive index 30°C	1.4666	1.4652
Refractive index Zeiss 30°C	62.8	79.0
Specific gravity 30°C	0.9284	0.9310
Saponification number	175.6	189.3
Iodine number	82.1	71.0

The ease with which the crop may be grown and harvested and the possibilities of the seed for the production of edible oil and food stuffs are main factors for the encouragement of its development. Furthermore, the climate of the Philippine Islands is admirably adapted for its extensive cultivation. It does not require special soil or care for its growth.

In China, Japan, and the Philippines soya bean is used for the manufacture of many varieties of food products. The similarity of the seguidillas bean to the soya bean in almost all its components leads to the conclusion that whatever uses can be made of the latter may also be made of the former. The oil extracted from the bean may be utilized for culinary purposes and for the manufacture of soap. The cake makes an excellent nitrogenous foodstuff which may be used as human food or as stock feed. The young pods when boiled with water and seasoned to taste make delicious greens similar to string beans in flavor.

SUMMARY

Characteristic samples of seguidillas beans and the oil obtained from the seeds of these beans were analyzed. The results obtained compare favorably with the corresponding data given in the literature for soya beans.

AN INEXPENSIVE METHOD FOR IMPROVING THE APPEARANCE OF BUNTAL FIBER OR OF ARTICLES MADE OF SUCH MATERIAL

By Salvador del Mundo

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The Bureau of Science receives many requests for information in regard to a comparatively inexpensive process for improving the appearance of buntal fiber, not only from various local hat dealers and commercial houses exporting native hats and fiber, but also from private parties. Information that may be valuable to the various people who are interested in the subject is given in this paper.

Buntal is the name given to the flexible material obtained from the fibrous bundles of the petiole of the matured leaf of buri palm, *Corypha elata*.[1] When recently and properly pulled from the petiole, these fibers are white and glossy, but when exposed to air and light they become discolored and acquire an ugly brownish tint. The fiber is extensively woven into baskets, handbags, and similar household articles of commercial value, but by far its most important industrial application is in the making of hats which are sold under the name of buntal Baliuag or Lucban, accordingly as the hats have been made in Baliuag, Bulacan, or in Lucban, Tayabas. Buntal hats have met with favorable reception in foreign countries and the demand has created a profitable home industry. By request of local firms engaged in exporting native hats, experiments were performed in this laboratory with a view of evolving a comparatively cheap process of improving the appearance of buntal fiber or hats.

In evolving the process outlined below, it was not the primary object to produce a perfect bleach such as may be accomplished with the use of more powerful bleaching agents, sodium peroxide for example. Rather, certain desirable features were borne in mind and duly incorporated in the method; namely, the relative low cost of materials required, the absence of any injurious

[1] See also Bureau of Education Technical Bull. 3 (1914) and the Philippine Craftsman 31 (1914) 45.

effect on buntal fiber, and the relative ease of manipulation involved. The present process was tried and thoroughly tested with a number of Baliuag and Lucban hats, and the results obtained were satisfactory even when the operator was inexperienced in the art of bleaching.

METHOD

Materials.—Two solutions are required, a bleaching agent to be designated as solution 1, and a decolorizing bath designated as solution 2.

Solution 1:	Parts.
Commercial potassium permanganate	5
Commercial sodium carbonate (dry)	2
Water	1,000

Preparation.—Measure out the required quantity of water. Add the solid ingredients a few portions at a time, stirring briskly to aid in dissolving the solid particles. To secure a homogeneous solution, continue stirring for some time after the complete solution of the solid chemicals.

Solution 2:	Parts.
Hypo (sodium thiosulphate)	20
Water	1,000
Dilute sulphuric acid sufficient to render acid.	
Note: Acidify solution 2 when it is ready for use.	

Preparation.—Pour the weighed amount of hypo into the measured quantity of water, a little at a time and with constant agitation. When all the hypo has dissolved, pour in about 2 cubic centimeters of commercial sulphuric acid for each liter of hypo solution. An excess of acid should be avoided. Stir. Note the evolution of a peculiar, pungent odor in the acidified hypo solution. The gas which causes this odor effects decolorization, and the absence of odor would tend to indicate that solution 2 is weak, in which case more acid should be added. Solution 2 becomes milky white in time on account of precipitated sulphur, but the turbidity is harmless and should cause no alarm.

PROCEDURE

Immerse the fiber or hats in solution 1; keep them there until they acquire a dark brown stain due to permanganate. The longer the hats are kept in solution 1, the better the bleach obtained. On the other hand, more time is required to decolorize the permanganate stain with solution 2. A little practice will enable one to determine when to remove the hats from solution 1. A bleach is usually secured after an immersion of from

one to two hours. A somewhat longer period is required when the solutions become weak. Solution 1 may be used repeatedly until it fails to stain the immersed hats to the required tint; when, of course, the solution may be strengthened by the addition of some crystals of potassium permanganate. A badly spent solution should be discarded.

When the immersed hats have become sufficiently darkened by exposure to permanganate, remove them from solution 1. Rinse well with water to remove the excess of permanganate and transfer to solution 2.

Keep the hats in solution 2 (with occasional shaking) until the brown stain acquired from the previous treatment is completely decolorized. If decolorization proceeds rather too slowly, a few more drops of acid should be added to solution 2. Too much acid should be avoided as it is detrimental to the fiber. Slow decolorization is commendable as it imparts a glossy finish to the bleached surface. When the stained hats have become completely decolorized, remove them from solution 2, and wash them well with water (running water preferred). If a piece of blue litmus paper is available, test for complete removal of residual acidity. The hats may now be set out to dry.

When solution 2 becomes too weak from continuous use or from prolonged standing, it often happens that the stains produced by the previous immersion in solution 1 are removed only with considerable difficulty or, in some cases, the stains are not removed at all; much, of course, to the alarm of the operator. Should this happen, a simple remedy lies in regenerating solution 2 by the addition of a few more drops of acid, or should it be feared to introduce too large an excess of acid, a freshly prepared solution should be secured.

Potassium permanganate is the only expensive chemical used in this process, but the amount of it required is so small as to make the expense from this source no drawback at all. Sodium carbonate is used to give solution 1 an alkaline reaction. It serves as a detergent for greasy material which may adhere to the fiber surface and hinder the bleaching action of permanganate. Sodium carbonate as well as hypo may be secured from any druggist at a low cost.

Very little attention is required by the method outlined above. After the hats have been dumped into the bleaching or decolorizing baths, all the attention required is occasional shaking and stirring. The procedure should cause no trouble even in the hands of beginners and inexperienced operators.

246827—7

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), V [1]

By Charles P. Alexander

Of Amherst, Massachusetts

TWO PLATES

The crane flies discussed at the present time are almost entirely from the mountains of Formosa, where they were collected by my friend Prof. Syuti Issiki. The most interesting series are those taken at Shōrei (Syōrei) at an altitude of 7,000 to 8,000 feet, in late October, representing a tipulid fauna that is quite characteristic of the Palæarctic Region in autumn. I am very greatly indebted to Professor Issiki for the privilege of retaining the types of the novelties described at this time.

In the present report, nine genera and subgenera of Tipulidæ are added to the Formosan fauna; namely, *Stibadocerella, Cyttaromyia, Discobola, Thaumastoptera, Ula, Troglophila, Pilaria, Cladura,* and *Neolimnophila.* This brings the total of generic and subgeneric groups for the island to more than seventy, a number that is greater than that of Europe or of America north of Mexico. The additional groups found in the major islands of Japan bring the number for the Japanese Empire to approximately one hundred, with several additional genera and subgenera that are regional and will almost certainly be taken as a result of future collecting.

TIPULINÆ

NESOPEZA BASISTYLATA sp. nov.

General coloration yellowish brown, the mesonotal præscutum with a narrow brown median vitta; antennæ relatively long, the basal segments yellow, the flagellum black; verticils of flagellar segments short; femora and tibiæ yellowish brown, the tarsi chiefly snowy white; wings suffused with brown, the stigma darker; abdomen dark brown, the segments ringed with yellow, especially the sternites; male hypopygium with the basistyles

[1] Contribution from the Department of Entomology, Massachusetts Agricultural College.

greatly produced into slender arms that are tufted with black setæ.

Male.—Length, about 8.5 millimeters; wing, 9.5; antennæ, about 3.3.

Female.—Length, about 8.5 millimeters; wing, 9.3.

Frontal prolongation of head pale brown, darker medially above; palpi dark brown. Antennæ (male) relatively long, the basal segments obscure yellow, the flagellar segments beyond the first passing into brownish black; flagellar segments elongate-cylindrical, gradually decreasing in length outwardly, clothed with a short, erect, pale pubescence and slightly longer black verticils that are more or less unilaterally arranged and shorter than the segments themselves. Head light brown.

Pronotum dark brown. Mesonotal præscutum rather light yellowish brown, with a narrow brown median line; posterior sclerites of mesonotum somewhat darker, especially the postnotal mediotergite; humeral region of præscutum restrictedly pale yellow. Pleura pale, the sternopleurite and meron darker, producing a more or less distinct longitudinally striped appearance. Halteres elongate, dark brown, the base of the stem restrictedly yellow. Legs with the coxæ yellowish testaceous; trochanters pale yellow; femora and tibiæ yellowish brown, the tarsi chiefly snowy white. Wings (Plate 1, fig. 1) with a strong brownish suffusion, the costal and apical regions somewhat darker; stigma conspicuous, dark brown, irregular in outline, oval, with a basal extension in cell Sc_1 almost to the fork of Sc; cord vaguely seamed with darker; a feebly indicated pale antestigmal spot; veins dark brown, the obliterative areas restricted. Venation: Sc_1 lacking; Sc_2 at near three-fourths the length of Rs, the latter arcuated; forks of medial field relatively shallow; m-cu at less than one-half its length before the fork of M.

Abdominal tergites chiefly dark brown, the basal segments with a yellowish triangle on either side at near midlength; sternites even more conspicuously banded, dark brown, the extreme base narrowly yellow, with an additional wider yellow ring at near midlength of the sclerite; subterminal segments with the basal pale ring lacking, becoming more uniformly darkened; hypopygium chiefly yellow. In the female, the banded abdominal pattern is much less distinct. Male hypopygium (Plate 2, fig. 25) with the ninth tergite, 9*t*, having the caudal margin blackened, trilobed, the lateral lobes larger and wider, the me-

dian lobe very low; on ventral surface back from each lateral lobe extends a blackened serrated bar. Basistyle, *b*, very greatly produced caudad, before midlength on mesal face with a tumid swelling set with abundant microscopic setulæ; beyond this enlargement, the style is slender, curved gently mesad, at apex with a tuft of black setæ. Outer dististyle, *od*, long and slender.

Habitat.—Formosa.

Holotype, male, Rantaizan, altitude 4,000 to 6,000 feet, May 20, 1928 (*S. Issiki*). Allotopotype, female.

CYLINDROTOMINÆ

Genus STIBADOCERELLA Brunetti

Stibadocerella BRUNETTI, Rec. Indian Mus. 15 (1918) 283.
Agastomyia DE MEIJERE, Bijd. tot de Dierkunde 21 (1919) 17.

The genus *Stibadocerella* has been represented only by two closely allied species, *S. pristina* Brunetti, from the Garo Hills, Assam, altitude 3,500 to 3,900 feet, collected in July by Kemp; and *S. albitarsis* (de Meijere) from Korinchi, Sumatra, taken in September by Jacobson. The discovery of a third closely allied species in Formosa is thus of great interest.

STIBADOCERELLA FORMOSENSIS sp. nov.

Thorax polished reddish brown, without distinct stripes; body with strong greenish tints; tips of fore tibiæ broadly white; wings with the second section of Rs longer than R_{4+5}, cell R_3 being relatively small; cell 1st M_2 large, exceeding the longest vein beyond it.

Female.—Length, about 12 millimeters; wing, 9.2.

Rostrum and palpi greenish brown. Antennæ with the scapal segments green, the flagellum black; antennæ about as long as the combined head and thorax. Head broad, greenish brown.

Mesonotum polished reddish brown, without distinct stripes, the margins and posterior sclerites with greenish tints. Halteres brownish black. Legs with the coxæ and trochanters green; femora brownish black; tibiæ black, the base narrowly ringed with white, more broadly so on the fore tibiæ; tips of fore tibiæ broadly white (2 millimeters); fore basitarsi much shorter than the tibiæ, black, the extreme tip pale; remainder of tarsi snowy white; posterior legs stouter, the tips of the tibiæ darkened; basitarsi with about the distal fourth white. Wings (Plate 1, fig. 2) with the coloration as in the other species, nearly hyaline, with very distinct black veins; stigma lacking. Venation: Basal section of Rs nearly straight, subequal to the second section;

R_{2+3} subperpendicular; R_{4+5} distinctly shorter than the second section of Rs, cell R_3 relatively short; cell 1st M_2 very large, exceeding in length the cells beyond, the second section of M_{1+2} equal to the outer section; m–cu longer than the distal section of Cu_1; vein 2d A represented by a marginal thickening to nearly opposite midlength of cell 1st A.

Abdomen chiefly greenish brown. Ovipositor with the valves unusually developed for a member of the Cylindrotominæ, the tergal valves especially well-formed, margined with conspicuous setæ, the basal half of the valve blackened, the outer half paling to green.

Habitat.—Formosa.

Holotype, female, Rantaizan, 4,000 to 6,000 feet, May 20, 1928 (*S. Issiki*).

It has generally been assumed that the second anal vein was lacking in this genus, but this is not exactly true. It is represented by an axillary marginal thickening, the cell itself being reduced to a linear strip lying proximad of the level of the arculus.

Through the kindness of Dr. Singh Pruthi, I have been able to examine a paratype of *S. pristina* Brunetti and have included a few supplementary notes concerning this species:

Male.—Length, about 10 millimeters; wing, 9.2; antennæ, about 13.

Antennæ (male) much longer than the body, as shown by the measurements, pale yellow, the outer segments of the flagellum darker. Body coloration as described by Brunetti. Præscutal stripes distinctly separated. Pale ring at base of tibiæ distinct; pale apex of fore tibiæ relatively wide (1.7 millimeters), slightly thickened, the setæ similarly white; fore and middle basitarsi about as long as the respective tibiæ, brown, only the extreme tips of each a little whitened. Wings (Plate 1, fig. 3) hyaline, the veins black. Venation: Sc_1 ending before r-m, Sc_2 at its tip; second section of Rs a little shorter than the basal section; R_{2+3} oblique; free tip of Sc_2 and R_{1+2} entirely atrophied; cell 1st M_2 large, roughly rectangular; m-cu longer than the distal section of Cu_1, vein Cu_2 evident to opposite m-cu; vein 1st A long, nearly straight; vein 2d A very short, opposite the arculus becoming confluent with the anal margin of the wing.

Genus CYTTAROMYIA Scudder

Cyttaromyia Scudder, Bull. U. S. Geol. Geogr. Surv. Terr. 3 (1877) 751; Proc. Am. Phil. Soc. 32 (1894) 190–194.

The genus *Cyttaromyia* has been known only from the Tertiary, having been especially characteristic of the Florissant beds of Colorado (Miocene). I am referring to this genus with some question a remarkable cylindrotomine fly from Formosa that is certainly distinct from *Cylindrotoma*. The venation of one wing of the unique type of the present species conforms closely to the essential features of the known species of *Cyttaromyia*, but the opposite wing has lost the supernumerary crossvein in cell R_5 that furnishes the chief character of the genus. The most notable features of the present fly are the very large, nearly contiguous eyes, the coarsely punctured thoracic dorsum and pleura (which reminds one strongly of the otherwise distinct *Stibadocera*), and the venation, cell M_1 being present, connected with vein R_{4+5} by a supernumerary or adventitious crossvein, forming an accessory discal cell immediately above the true cell 1st M (Plate 1, fig. 4), the last feature possibly not constant. It should be noted that the present fly disagrees with Scudder's definition of *Cyttaromyia* in the loss of Sc_1 and in the presence of tibial spurs.

CYTTAROMYIA TAIWANIA sp. nov.

General coloration black, the thorax coarsely punctured; antennæ (male) elongate, nearly as long as the body, the flagellar segments cylindrical, with short verticils; eyes (male) almost contiguous on anterior vertex.

Male—Length, about 7 millimeters; wing, 7; antennæ, about 6.5.

Rostrum and palpi black. Antennæ dark brown, in male nearly as long as the body; flagellar segments elongate-cylindrical, with scattered pubescence and verticils that are much shorter than the segments; antennal segments broken beyond the twelfth; flagellar segments gradually increasing in length to the fifth or sixth, thence shortening outwardly. Head dull black, impunctate; eyes large, with coarse ommatidia, in the male almost contiguous on the anterior vertex.

Mesonotum black, the surface with conspicuous coarse punctures, the three præscutal stripes and centers of the scutal lobes nearly smooth. Pleura black, the extensive dorsopleural membrane pale yellow; pleura, except the sternopleurite, with numerous coarse punctures. Halteres elongate, infuscated, the base of the stem narrowly pale yellow. Legs with the coxæ smooth, brownish black; trochanters obscure yellow; femora obscure yellow, the tips slightly more infuscated; tibiæ brownish yellow,

the tips very narrowly darkened; tarsi obscure yellow, passing into black. Wings (Plate 1, fig. 4) with a uniform grayish brown suffusion, without a stigma; veins dark brown. Venation: Sc_1 lacking, Sc_2 ending just before the fork of Rs; Rs long, arcuated at origin, in alignment with R_{4+5}; R_{2+3} interstitial with r-m, arising at end of Rs; free tip of Sc_2 preserved; distal end of R_2 entirely atrophied; a supernumerary crossvein in cell R_5 of the right wing of type, lacking in the left wing; medial field as in *Cylindrotoma;* m before to just beyond the fork of M_{1+2}; m-cu beyond midlength of cell 1st M_2, subequal to the distal section of Cu_1.

Abdomen elongate, brownish black, nearly smooth except for the transverse impressed areas; hypopygium black.

Habitat.—Formosa.

Holotype, male, Rantaizan, altitude 4,000 to 6,000 feet, May 20, 1928 (*S. Issiki*).

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) CLITELLIGERA sp. nov.

Thorasic dorsum chiefly polished black; pleura, pleurotergite, and scutellum reddish yellow; femora obscure yellow, the tips weakly darkened; wings grayish, the cells beyond the cord strongly darkened; most veins of wing seamed with brown; Sc long; R_2 and free tip of Sc_2 in transverse alignment; m-cu beyond fork of M; anal veins divergent.

Female.—Length, about 8 millimeters; wing, 9.

Rostrum and palpi dark brown; terminal segment of maxillary palpi small. Antennæ black throughout; flagellar segments with the verticils of upper surface very long, arranged unilaterally in pairs; outer flagellar segments elongate. Head dull black, the restricted frons gray; eyes large, nearly contiguous on the dorsum, restricting the anterior vertex at this point to a linear strip.

Pronotum, mesonotal præscutum, and scutal lobes polished black, the humeral region of the præscutum very restrictedly pale; median region of scutum and scutellum reddish brown; postnotal mediotergite black. Pleura and pleurotergite uniformly reddish yellow, including the dorsopleural membrane. Halteres obscure yellow, the knobs dark brown. Legs with the coxæ and tronchanters reddish yellow; femora obscure yellow, the tips weakly darkened; remainder of legs obscure yellow, the terminal tarsal segments black; legs relatively long and slender.

Wings (Plate 1, fig. 5) dimidiate, the cells beyond the cord strongly darkened, the basal cells more grayish; costal region, and especially cell Sc, more darkened; stigma short-oval, brown; prearcular cells and axillary region darkened; a large cloud at origin of Rs; narrow but conspicuous brown seams along Cu, the cord and outer end of cell 1st M_2; other longitudinal veins less distinctly seamed with brown; veins dark brown. Venation: Sc very long, ending some distance beyond r-m; R_2 and free tip of Sc_2 pale, in transverse alignment; Rs arcuated at origin, more than three times the basal section of R_{4+5}; radial veins long, generally parallel cell 1st M_2 relatively small; m-cu a little less than its length beyond the fork of M; anal veins gently divergent at base.

Abdominal tergites dark brown, the outer segments more reddish brown; sternites more yellowish brown. Ovipositor with the genital segment obscure yellow; tergal valves slender, gently curved; sternal valves stouter, their bases darkened.

Habitat.—Formosa.

Holotype, female, Rantaizan, altitude 4,000 to 6,000 feet, May 20, 1928 (*S. Issiki*).

The peculiar body coloration and wing pattern readily separate the present species from other described species of *Libnotes*.

LIMONIA (LIMONIA) TENUICULA sp. nov.

General coloration yellowish brown, the præscutum with a median dark brown discal area; antennæ moniliform, black throughout; wings with a pale brown tinge, the stigma darker; Sc_1 ending beyond midlength of Rs; inner end of cell 1st M_2 strongly arcuated; m-cu beyond the fork of M; male hypopygium with the ventral dististyle small, the rostral prolongation small, without spines.

Male.—Length, about 4.5 millimeters; wing, 5.5.

Rostrum and palpi brownish black. Antennæ brownish black throughout; flagellar segments strongly nodulose, the segments short-oval with glabrous apical necks; terminal segment elongate, narrowed to a point. Head dark blackish gray.

Mesonotal præscutum brownish yellow, the disk polished dark brown to brownish black, restricting the ground color to the humeral and lateral portions; remainder of mesonotum dark brown. Pleura yellowish brown. Halteres relatively short, dark brown, the base of the stem narrowly yellow. Legs with the coxæ and trochanters yellowish testaceous; femora pale brown, passing to darker at tips; tibiæ and tarsi pale brownish

yellow, the terminal tarsal segments darker. Wings (Plate 1, fig. 6) relatively narrow, with a pale brownish tinge, the short-oval stigma darker brown; veins dark brown. Venation: Sc relatively long, Sc_1 ending shortly beyond midlength of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in alignment; inner end of cell 1st M_2 strongly arcuated; veins beyond cell 1st M_2 elongate; m-cu about one-third its length beyond the fork of M.

Abdominal tergites dark brown, the sternites somewhat paler. Male hypopygium (Plate 2, fig. 26) with the tergite, 9*t*, transverse, each low lateral lobe with about four long setæ; what appears to be the median ventral portion of the tergite is produced into a rectangular plate that is densely set with short even setæ. Basistyle, *b*, long, the ventromesal lobe relatively small. Dorsal dististyle apparently represented by a simple nearly straight rod, the tip acute. Ventral dististyle, *vd*, very small, the main body of the organ about the size of the lobe of the basistyle, with a few long setæ, the mesal apical portion produced into a small slender spinous beak; rostral prolongation very large and flattened, without evident armature other than setæ.

Habitat.—Formosa.

Holotype, male, Shinten, April 15, 1928 (*S. Issiki*).

LIMONIA (DISCOBOLA) MARGARITA (Alexander).

Discobola margarita ALEXANDER, Philip. Journ. Sci. 24 (1924) 539–540.

Known hitherto only from Karafuto and Hokkaido, northern Japan. A female, Mount Rantaizan, Formosa, altitude 7,000 feet, June 3, 1927 (*S. Issiki*).

LIMONIA (DISCOBOLA) ARGUS (Say).

Limnobia argus SAY, Long's Exped., Append. (1824) 358.

A wide-ranging species in northern North America and northeastern Asia, not before recorded from south of the main island of Japan. A female, Shorei, Formosa, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

LIMONIA (DICRANOMYIA) AURITA sp. nov.

Belongs to the *morio* group; size large (wing, male, over 7 millimeters); Sc_1 long; male hypopygium with the caudolateral angles of the tergite produced into long slender arms; ventromesal lobe of basistyle long, boomerang-shaped; outer dististyle bifid at apex.

Male.—Length, about 7.5 millimeters; wing, 7.4.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval to long-oval. Head black, the frons more silvery pruinose.

Mesonotum polished black, the median region of the scutum, the scutellum, and the cephalic portion of the postnotal mediotergite slightly more pruinose. Pleura black, with a gray pruinescence. Halteres yellow, the knobs brownish black. Legs with the fore and middle coxæ polished black, the apices more yellowish; posterior coxæ obscure yellow, trochanters yellow; remainder of legs black, the femora yellow basally, narrowest on the fore femora where about the basal fourth is included, least evident on the posterior femora where only the tips are darkened. Wings (Plate 1, fig. 7) with a brownish tinge, the oval stigma darker brown; veins dark brown. Venation: Sc short, Sc_1 ending shortly before the origin of Rs, Sc_2 far before the tip, Sc_1 alone being nearly as long as Rs; free tip of Sc_2 shortly proximad of the level of R_2; m-cu shortly before the fork of M, subequal to the distal section of Cu_1; vein 2d A relatively long.

Abdomen black, the caudal margins of the basal sternites obscure yellow; hypopygium chiefly dark. Male hypopygium (Plate 2, fig. 27) with the ninth tergite, *9t*, transverse, the outer lateral angles produced caudad and slightly mesad into long slender arms that are tipped with short setæ. Basistyle, *b*, relatively small, the ventromesal lobe large and of very unusual form, being more or less boomerang-shaped, the outer margin at the angulation with a few longer setæ; a small tubercle on mesal face of basistyle toward apex; a conspicuous pencil of long setæ that are curved at tips, located near base of style. Outer dististyle, *od*, bifid and blackened at apex. Inner dististyle, *id*, fleshy, irregular in shape, the rostral prolongation very stout, with a single pale spine. Gonapophyses with the mesal apical angle slender.

Habitat.—Formosa.

Holotype, male, Ritozan, altitude 5,000 feet, August 1, 1928 (*S. Issiki*).

Limonia (*D.*) *aurita* is very distinct from the other regional members of the *morio* group. The peculiar characters of the basistyle and outer dististyle of the male hypopygium are suggested by *L.* (*D.*) *pseudomorio* Alexander (Japan).

LIMONIA (DICRANOMYIA) MONTIUM sp. nov.

General coloration brownish gray, the pronotum and mesonotal præscutum with a median dark brown stripe; antennæ entirely black; wings grayish, the oval stigma darker; Sc_1 ending

shortly beyond, Sc_2 nearly opposite, the origin of Rs; cell 1st M_2 relatively large; m-cu at the fork of M; male hypopygium with a single spine on the rostral prolongation of the ventral dististyle.

Male.—Length, about 6.5 millimeters; wing, 8.2.

Rostrum black, sparsely pruinose; palpi black. Antennæ black throughout; flagellar segments subglobular, passing into oval, the terminal segment longer than the penultimate; segments clothed with a dense white pubescence. Head grayish brown; anterior vertex of moderate width, with an impressed median line.

Pronotum gray, black medially. Mesonotal præscutum brownish gray with a median dark brown stripe that is slightly constricted before midlength, somewhat wider behind; posterior sclerites of the mesonotum dark gray, the centers of the scutal lobes dark brown. Pleura dark brown, heavily pruinose. Halteres yellow, the knobs weakly infuscated. Legs with the fore and middle coxæ dark, pruinose; posterior coxæ and all trochanters yellow; femora obscure brownish yellow at base, passing into dark brown at tips; remainder of legs black. Wings (Plate 1, fig. 8) with a grayish tinge, the oval stigma darker; veins dark brown, with long conspicuous black macrotrichia. Venation: Sc_1 ending shortly beyond the origin of Rs, Sc_2 immediately before this origin; Rs about two and one-half times the more-arcuated basal section of R_{4+5}; free tip of Sc_2 and R_2 in approximate alignment; cell 1st M_2 large, longer than the veins beyond it; basal section of M_3 arcuated to feebly angulated; m-cu at fork of M.

Abdomen brownish black, sparsely pruinose. Male hypopygium (Plate 2, fig. 28) with the ninth tergite, *9t*, transverse, the caudal margin gently emarginate, the lateral lobes low. Basistyle, *b*, relatively small, the ventromesal lobe large, obtuse. Outer dististyle, *od*, only moderately curved, the tip suddenly narrowed into a slightly decurved black point. Ventral dististyle, *id*, large and fleshy, the rostral prolongation flattened, the tip twisted and pendulous; a single rostral spine of moderate size. Gonapophyses, *g*, with the mesal apical lobe stout, its lateral margin microscopically serrulate.

Habitat.—Formosa.

Holotype, male, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

LIMONIA (ALEXANDRIARIA) ATAYAL sp. nov.

General coloration brown; præscutum obscure yellow with three brown stripes, the lateral stripes broad, reaching the lateral margins or nearly so; wings with a strong brownish suffusion; Sc long, Sc_1 ending almost opposite the origin of Rs, Sc_2 far from its tip; Rs longer than the basal section of R_{4+5}

Female.—Length, about 4.2 millimeters; wing, 5.

Rostrum and palpi black. Antennæ black throughout. Head dark brown.

Mesonotal præscutum obscure brownish yellow, with three brown stripes, the median stripe entire; lateral stripes broad and diffuse; humeral region of sclerite brighter yellow; scutal lobes dark brown, the median area and disk of scutellum paler; remainder of mesonotum dark brown. Pleura obscure yellow, striped longitudinally with dark brown, including the ventral anepisternum and the ventral sternopleurite. Halteres infuscated, the base of the stem narrowly obscure yellow. Legs with the fore coxæ infuscated, the remaining coxæ and trochanters obscure yellow; remainder of legs broken. Wings (Plate 1, fig. 9) with a strong brown suffusion, the oval stigma very slightly darker; veins dark brown. Venation: Sc unusually long, Sc_1 ending just before the origin of Rs, Sc_2 far from its tip; Rs longer than the basal section of R_{4+5}; free tip of Sc_2 and R_2 in alignment, both pale; m-cu at fork of M, longer than the distal section of Cu_1.

Abdominal tergites dark brown; sternites paler brownish yellow. Ovipositor with the tergal valves long and straight, the tips obtuse.

Habitat.—Formosa.

Holotype, female, Shinten, April 15, 1928 (*S. Issiki*).

ORIMARGA FUSCIVENOSA sp. nov.

General coloration of head and thorax dark plumbeous; halteres and legs dark; wings with a faint brownish tinge, the veins brownish black, very conspicuous; R_2 and R_{1+2} subequal; basal section of R_{4+5} angulated before midlength.

Male.—Length, about 5 millimeters; wing, 5.

Rostrum and palpi black. Antennæ black throughout. Head dark plumbeous gray.

Mesonotum and pleura entirely dark plumbeous gray. Halteres infuscated. Legs with the coxæ and trochanters dark brown; remainder of legs black. Wings (Plate 1, fig. 10) with a faint brownish tinge, the veins brownish black, very conspicuous; wing apex in radial field narrowly margined with brown;

costal vein incrassated; costal fringe relatively long and conspicuous. Macrotrichia of medial field beyond cord long and conspicuous. Venation: Sc_1 ending about opposite midlength of Rs, Sc_2 near its tip; free tip of Sc_2 nearly three times its length before R_2; R_2 subequal to R_{1+2}; basal section of R_{4+5} angulated and weakly spurred before midlength; r-m distal of level of R_2; petiole of cell M_3 short; m-cu about opposite one-fifth the length of Rs; vein 2d A produced, the cell narrowed and acute at outer end.

Abdominal tergites dark brown, the sternites a little paler; hypopygium black.

Habitat.—Formosa.

Holotype, male, Shinten, April 15, 1928 (*S. Issiki*).

Orimarga fuscivenosa is most closely allied to *O. taiwanensis* Alexander, likewise from Formosa, differing in the uniform dark plumbeous gray coloration, including the thoracic pleura, and the very dark wing veins, which are provided with long conspicuous macrotrichia. The details of venation are similarly distinct, including the position of Sc_2, the distinctness of the free tip of Sc_2, the longer Rs, with cell R_1 relatively longer and narrower, and the more-pointed 2d anal cell.

Genus THAUMASTOPTERA Mik

Thaumastoptera MIK, Verh. zool.-bot. Ges. Wien 16 (1866) 302.

The genus *Thaumastoptera* was proposed for the single species, *calceata* Mik, now known to be widely distributed in Europe. The only other described species are the Oligocene *T. electra* Alexander, from the Baltic amber, and *T. undulata* (Cockerell and Haines), from the Gurnet Bay deposits. It is thus a matter of great interest to record a species of the genus from the high mountains of Formosa. The presence of three supernumerary crossveins in the wings of the new species requires the formation of a new subgeneric group that is described below as *Taiwanita*. This venational condition would appear closely to parallel that found in *Limonia* and its subgenus *Discobola* Osten Sacken. The supernumerary and other transverse elements in the wing of *Taiwanita* (Plate 1, fig. 11) form an irregular cordlike arrangement lying proximad of the true cord, these crossveins and deflections being Sc_2, the basal section of Rs, the supernumerary crossvein in cell R, the m-cu crossvein, and the supernumerary crossveins in cells Cu and 1st A. It should be noted that a supernumerary crossvein in cell Cu is not known in any other crane fly. The members of the genus *Thaumastoptera* are peculiar in the

habits of the larvæ, which live in cold springs and construct a portable case.[2]

Subgenus TAIWANITA novum

Characters as in typical *Thaumastoptera*, differing especially in the venation. Supernumerary crossveins in cells R, Cu, and 1st A.

Type of the subgenus, *Thaumastoptera* (*Taiwanita*) *issikiana* sp. nov. (Eastern Palæarctic Region).

THAUMASTOPTERA (TAIWANITA) ISSIKIANA sp. nov.

General coloration grayish white; antennæ with the basal segments infuscated, the outer segments paling to yellow; legs yellow, the femoral tips conspicuously blackened; wings pale yellow, variegated with brown areas on the crossveins and deflections and numerous gray dots in the cells; supernumerary crossveins in cell R, Cu, and 1st A.

Male.—Length, about 4 millimeters; wing, 5.

Rostrum obscure brownish yellow; maxillary palpi black. Antennæ with the scapal segments brownish testaceous; basal segments of flagellum infuscated, the outer segments passing into yellow; basal flagellar segments oval, the outer segments more elongated; all segments with long powerful setæ that exceed the segments in length. Head pale grayish white.

Mesonotum pale grayish white, without markings, the lateral portions of the præscutum more yellowish; posterior mediotergite a little infuscated. Pleura pale yellow, with a dusky cloud on the dorsopleural region. Halteres white. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips conspicuously blackened, preceded by a narrow more whitish ring; remainder of legs pale yellow. Wings (Plate 1, fig. 11) pale yellow, handsomely variegated with dark brown seams on the veins and numerous pale gray dots in the cells; the darker seams include the arculus, origin of Rs, all crossveins and deflections of veins, tips of Sc_1, and all longitudinal veins; the gray dots occur in all cells; veins pale yellow, darker in the seamed areas. Venation: Sc long, Sc_1 ending about opposite three-fourths the length of Rs, Sc_2 just before the origin of the latter; Rs angulated, with a supernumerary crossvein at the angulation, connecting posteriorly with M; R_2 in transverse alignment with R_{1+2}; inner end of cell R_3 lying a little proximad of cell 1st M_2; m-cu nearly twice its length before the fork of M; a supernumerary

[2] Lenz, Fr., Thaumasoptera calceata Mik, eine gehäusetragente Tipulidenlarve, Archiv für Naturgeschichte 85, Abt. A., Heft 4 for 1919 (1920) 114–136, figs. 1–28.

crossvein in cell Cu at near midlength, this completely traversing vein Cu_2; a supernumerary crossvein in cell 1st A, connecting with vein 2d at near two-thirds its length.

Abdomen pale yellow, the pleural region more darkened. Male hypopygium (Plate 2, fig. 29) with the dististyle, *d*, single, as in the genus, appearing as a flattened blade, the apex produced into a slender acute point, the outer margin with a small appressed tooth.

Habitat.—Formosa.

Holotype, male, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

HELIUS (HELIUS) NAWAIANUS sp. nov.

Mesonotum reddish yellow, the cephalic half of the præscutum with a dark brown median stripe; antennæ (male) relatively long, about twice as long as the combined head and rostrum; abdomen dark brown, the hypopygium yellow; male hypopygium with the outer dististyle terminating in two obtuse spines, the outer margin with three long powerful setæ.

Male.—Length, about 6.5 millimeters; wing, 7.5.

Female.—Length, about 8.5 millimeters; wing, 7.8.

Rostrum and palpi dark brown. Antennæ relatively elongated, as in *H. nipponensis*, about twice as long as the combined head and rostrum, dark brown; flagellar segments cylindrical, with a dense white pubescence and short scattered black verticils. Head gray.

Pronotum dark brown medially, paler laterally. Mesonotum reddish yellow, the cephalic half of the præscutum with a dark brown median stripe, the remainder of the notum unmarked. Pleura reddish yellow. Halteres pale. Legs with the coxæ and trochanters concolorous with the pleura; femora obscure yellow, the tips narrowly infuscated; tibiæ brownish yellow, the tips vaguely darkened; tarsi passing into brownish black beyond bases. Wings with a very pale brownish tinge, the stigma only slightly darker; veins dark brown. Venation: Sc_1 ending just before the fork of Rs, Sc_2 at its tip; Rs nearly straight; cell 1st M_2 large, the proximal end wider; m-cu close to the fork of M.

Abdomen dark brown, the basal sternites a very little paler; hypopygium and subterminal segments yellow. Male hypopygium with the outer dististyle, *od* (Plate 2, fig. 30), ending in two subequal blackened knobs, or obtuse spines, not produced into a long apical spine as in *H. nipponensis* (Plate 2, fig. 31); on outer margin before apex with three long powerful setæ that

are entirely lacking in *nipponensis, brevioricornis,* and allied forms.

Habitat.—Japan (Honshiu).

Holotype, male, Ōi, Gifu, June 6, 1923 (*R. Takahashi*). Allotopotype, female.

Helius nawaianus is named in honor of the great pioneer entomologist of Japan. In *H. nipponensis* Alexander the præscutum has three distinct stripes, the centers of the scutal lobes are blackened, and the abdomen is much paler.

HELIUS (HELIUS) LILIPUTANUS sp. nov.

Size very small (wing, male, under 3.5 millimeters); rostrum elongated; thorax ocherous yellow; wings grayish subhyaline, without a distinct stigma; Sc short; cell M_2 open by the atrophy of m; abdominal segments conspicuously bicolorous.

Male.—Length, excluding rostrum, about 3 mllimeters; wing, 3.2; rostrum, about 1.1.

Rostrum elongated, dark brown, exceeding the combined head and thorax. Antennæ brownish black, with only fifteen apparent segments; first flagellar segment large; terminal segment reduced to a tiny button; verticils long and conspicuous, much exceeding the segments, more elongate on the outer segments. Head pale, the anterior vertex narrow.

Thorax pale ocherous yellow, the mesonotum somewhat darker behind; sternopleurite slightly infuscated. Halteres dark brown, the base of the stem narrowly pale. Legs with the coxæ and trochanters pale yellow, those of the fore legs somewhat darker; remainder of legs broken. Wings (Plate 1, fig. 12) grayish subhyaline, the stigma scarcely darkened; wing margin in radial field narrowly and vaguely seamed with brown; veins pale brown. Venation: Sc short, Sc_1 ending about opposite midlength of the short Rs, Sc_2 at its tip; veins R_3 and R_{4+5} at wing margin widely divergent, cell R_3 being unusually wide; cell M_2 open by the atrophy of m; m-cu nearly its own length beyond the fork of M, longer than the distal section of Cu_1; cell 2d A narrow.

Abdominal segments conspicuously bicolorous, the bases broadly obscure yellow, the slightly narrower apical portions dark brown; subterminal segments uniformly darkened, forming a ring; hypopygium chiefly pale. Male hypopygium (Plate 2, fig. 32) with a conspicuous interbasal rod, *i*. Outer dististyle, *od*, slender, bifid at apex, the outer tooth broken near base in the unique type.

Habitat.—Formosa.

Holotype, male, Michishita, altitude 4,000 feet, July 31, 1928 (*S. Issiki*).

The structure of the outer dististyle is generally similar to *Taiwanina pandoxa* Alexander, and it is very possible that the latter genus is more correctly placed near *Helius* despite the reduced palpi, peculiar antennal structure, and shape of the thorax.

HEXATOMINI

ULA SUPERELEGANS sp. nov.

General coloration black, pruinose; antennæ elongate; wings yellowish, with a heavy brown pattern, including a large area surrounding Sc_2; stigma yellow, both ends darkened; abdominal tergites black, the caudal margins narrowly ringed with obscure yellow; sternites dark, the incisures broadly yellow.

Female.—Length, about 6.5 to 7 millimeters; wing, 7 to 8.

Rostrum and palpi black. Antennæ elongate, in female, if bent backward, extending to some distance beyond the wing root; scapal segments obscure yellow, the flagellum black; flagellar segments fusiform, with long conspicuous verticils. Head brownish gray.

Mesonotum black with a conspicuous brownish yellow pollen, the scutellum and postnotum somewhat more pruinose. Pleura black, sparsely pruinose; dorsopleural membrane dusky. Halteres dusky, the basal half of the stem yellow, the knobs more infuscated. Legs with the coxæ brownish yellow, paler apically; trochanters obscure brownish yellow; femora brownish black, the bases obscure yellow, more broadly so on the posterior legs; tibiæ yellowish brown to brownish black, the tips still darker; tarsi passing into black. Wings with a yellowish color, variegated with a very heavy brown pattern, including extensive seams at Sc_2, origin of Rs, along the cord from the costa at Sc_1 to Cu; outer end of stigma surrounding R_2 and R_{1+2}; outer end of cell 1st M_2; narrower dusky clouds at wing apex, as marginal areas at ends of radial veins and as a conspicuous seam for almost the whole length of the distal section of Cu_1; stigma chiefly yellow, brighter than the ground color; veins dark brown. The holotype has an additional small linear dark seam in cell 1st A. Macrotrichia of cells nearly lacking in the proximal ends of the basal cells, including nearly the basal half of 2d A. Venation: Rs angulated at origin, forking at r-m; m-cu nearly in alignment with r-m.

Abdominal tergites black, the segments narrowly ringed caudally with obscure testaceous yellow; sternites similar, the inci-

sures broadly and conspicuously obscure yellow, this including both the bases and apices of the segments; subterminal segments more uniformly blackened. Ovipositor with the base of the genital segment infuscated, the remainder brownish yellow; tergal valves strongly upcurved to the very acute tips, the dorsal margin at base with a low obtuse darkened tooth.

Habitat.—Formosa.

Holotype, female, Shōri, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*). Paratopotype, female.

Ula superelegans sp. nov. and *U. fuscistigma* sp. nov. are distinct from the two species known from northern Japan, *Ula perelegans* Alexander and *U. cincta* Alexander.

ULA FUSCISTIGMA sp. nov.

General coloration black, pruinose; antennæ elongate; wings grayish, the stigma uniformly brown; large subcircular brown clouds at origin of Rs and on anterior cord; abdomen uniformly darkened.

Female.—Length, about 7 millimeters; wing, 7.2.

Rostrum and palpi black. Antennæ (female) elongate; scape dark brown, the flagellum black. Head dark gray.

Thorax black, the mesonotum sparsely pruinose, the scutellum and postnotum more heavily so. Pleura conspicuously pruinose, especially the ventral pleurites; dorso pleural region dark. Halteres pale, the knobs dark brown. Legs with the coxæ dark brown, the trochanters more brownish yellow; femora brownish yellow, passing into black; remainder of legs black. Wings (Plate 1, fig. 13) grayish, the stigma uniformly darkened; conspicuous subcircular brown clouds at origin of Rs and on anterior cord; narrower seams on posterior cord and outer end of cell 1st M_2; a tiny brown seam on Sc_2; veins dark brown. Macrotrichia of cells lacking only at extreme wing base, including about the basal third of cell 2d A. Venation: Rs forking just beyond r-m; R_{1+2} a trifle longer than R_2 alone; cell 1st M_2 relatively small.

Abdominal tergites black, the sternites a little paler, the pleural membrane dark; ovipositor yellowish horn-color, the tergal valves relatively broad, upcurved to the acute tips.

Habitat.—Formosa.

Holotype, female, Shōri, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

PSEUDOLIMNOPHILA AUTUMNALIS sp. nov.

General coloration gray, the præscutum with four narrow brown stripes; antennæ black, the base of the first flagellar seg-

ment yellow; legs chiefly brown, the tarsi passing into black; wings with a grayish brown suffusion, the pearcular and costal regions more yellowish; stigma and a vague pattern on the disk darker; distal section of Cu_1 straight; male hypopygium with the ædeagus short.

Male.—Length, about 8 millimeters; wing, 9.3.

Female.—Length, about 7 millimeters; wing, 8.2.

Rostrum brown, the palpi darker brown. Antennæ (male) relatively short, if bent backward, extending to just beyond the wing root; antennæ black, the basal third of the first flagellar segment yellow; flagellar segments subcylindrical, with verticils that exceed the segments. Head brownish gray, clearer gray in front.

Pronotum gray, the lateral portions of the scutellum obscure yellow. Mesonotal præscutum gray with four brown stripes, the intermediate pair separated by a capillary gray line; pseudosutural foveæ small, black; no tuberculate pits; remainder of mesonotum gray, the scutal lobes variegated with brown. Pleura gray. Halteres dusky, the base of the stem narrowly pale; in the paratype, the apices of the knobs slightly paler. Legs with the coxæ brownish gray basally, the apices pale; trochanters obscure yellow, margined with brown; femora brownish yellow, paler basally, the tips passing into dark brown; tibiæ and tarsi dark brown, the latter passing into black. Wings (Plate 1, fig. 14) with a grayish brown suffusion, the prearcular and costal regions more yellowish; stigma darker; very vague and diffuse clouds at origin of Rs, along cord and outer end of cell 1st M_2; axillary region darkened; veins dark brown. Macrotrichia of veins unusually long and conspicuous; costal fringe short in both sexes. Venation: Sc_1 ending about opposite r-m, Sc_2 at its tip; Rs angulated at origin; R_{2+3+4} relatively long, gently arcuated, longer than R_{2+3}; R_2 subequal to R_{1+2}; cell 1st M_2 short, m-cu at near two-thirds its length; cell M_1 deep, its petiole subequal to or shorter than m-cu; distal section of Cu_1 straight; vein 2d A long, gently sinuous.

Abdominal tergites dark brown, the central portion more yellowish to produce a more or less distinct dorsomedian vitta; subterminal segments and hypopgium entirely blackened; sternites infuscated, the intermediate segments with a large yellowish triangle on posterior half, the point directed cephalad. Male hypopygium (Plate 2, fig. 33) with the tergite, 9*t*, deeply notched. Basistyle short and broad. Outer dististyle, *od*, narrowed to the simple apex, the outer surface setiferous. Inner

dististyle with the basal half enlarged, the outer margin with numerous conspicuous erect setæ, the apical point elongate. Ædeagus short. What appears to represent an interbasal process appears as a trispinous structure, as figured.

Habitat.—Formosa.

Holotype, male, Mareppa, altitude 6,000 feet, October 25, 1928 (*S. Issiki*). Allotype, female, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*). Paratopotype, male.

The only similar grayish *Pseudolimnophila* from this general region is *P. horii* Alexander (Japan), which differs in the general coloration of the body and wings, the yellow halteres, the venation, as the strongly curved distal section of Cu_1, and the structure of the male hypopygium.

TROGLOPHILA RITOZANENSIS sp. nov.

General coloration brown, the humeral region of the præscutum more yellowish; head brownish gray; wings with a brown tinge; Rs and R_{2+3+4} subequal, the former slightly more arcuated; m-cu just before the fork of M.

Female.—Length, about 3.5 millimeters; wing, 4.6.

Rostrum and palpi pale brown. Antennæ (female) of moderate length only, if bent backward extending about to the wing root; antennæ dark brown. Head brownish gray.

Mesonotum brown, the humeral region of præscutum more yellowish. Pleura brown. Halteres dusky, the base of the stem narrowly yellow. Legs with the coxæ brownish testaceous, the posterior coxæ paler; remainder of legs pale brown, the setæ dark. Wings (Plate 1, fig. 15) with a faint brownish tinge, the stigma scarcely darker; veins and macrotrichia dark brown. Venation: Sc relatively long, Sc_1 ending just beyond r-m, Sc_2 a short distance from the tip of Sc_1; Rs relatively short, arcuated, subequal to or slightly longer than the more gently arcuated R_{2+3+4}; R_2 very faint, R_{2+3} nearly as long as R_{1+2}, the latter less than one-half $R_1 + Sc_2$; m-cu shortly before the fork of M.

Abdomen uniform brown, the sternites a little paler. Ovipositor with the valves fleshy, terminating in a slender pale setoid structure.

The left wing of the type has cell M_1 present as a small areole that is less than one-fifth the length of the petiole.

Habitat.—Formosa.

Holotype, female, Ritozan, altitude 5,000 feet, August 1, 1928 (*S. Issiki*).

Troglophila ritozanensis is most closely allied to *T. alticola* (Edwards), of Borneo. It cannot be stated whether the condi-

tion of having cell M_1 preserved is normal, the venation of the two wings of the type being conspicuously unlike.

LIMNOPHILA (TRICHOLIMNOPHILA) CÆSIELLA sp. nov.

Male.—Length, 7.5 to 8 millimeters; wing, 7 to 7.5.

Closely allied and generally similar to *L.* (*T.*) *pilifer* Alexander, differing in the slightly longer antennæ and details of coloration.

Rostrum and head light gray. Antennæ longer than in *L. pilifer,* if bent backward extending approximately to the root of the halteres, pale brown. Mesothorax entirely gray, the præscutal stripes scarcely evident, the pruinosity including the entire præscutum. Male hypopygium with the lobes of the tergite long and more expanded at apices, the notch inclosed thus more or less narrowed at outer end.

Habitat.—Japan (Kiushiu).

Holotype, male, Hirao Hill, near Fukuoka, April 5, 1924 (*H. Hori*). Paratopotypes, 1 male, with type; 2 males, Fukuoka, April 13, 1924 (*H. Hori*).

The specimens of the rather extensive series of *L. pilifer* before me all show the cephalic portion of the median præscutal stripe highly polished and shiny black.

LIMNOPHILA RANTAIZANA sp. nov.

General coloration brownish yellow; antennæ (male) short; wings brownish yellow, with a weak dark pattern; macrotrichia of veins long and conspicuous; inner ends of cells R_4, R_5, and 1st M_2 in oblique alignment; male hypopygium with the median region of the tergite produced caudad into a bilobed rod.

Male.—Length, about 5.5 millimeters; wing, 6.8.

Rostrum yellow; palpi dark brown. Antennæ (male) short, if bent backward extending to opposite or just beyond the wing root; pale brownish yellow, the outer segments somewhat darker; flagellar segments long-oval, with a dense pale pubescence and verticils that slightly exceed the segments. Head grayish ocherous, the center of the broad vertex a little darkened.

General coloration of the thorax brownish yellow, subnitidous, without evident markings; pseudosutural foveæ concolorous with the præscutum; no tuberculate pits. Pleura testaceous yellow. Halteres relatively long and slender, obscure yellow, the knobs more darkened. Legs with the coxæ and trochanters pale yellow; femora brownish yellow, a little darkened outwardly; tibiæ and tarsi pale brown, the outer tarsal segments somewhat darker; legs conspicuously hairy. Wings (Plate 1, fig. 16) with a strong

brownish yellow tinge; stigma oval, darker brown, very vague and restricted; dark seams on anterior cord; veins brown, the macrotrichia long and conspicuous. Venation: Sc_1 ending just before the fork of Rs, Sc_2 a short distance from its tip; Rs long and gently arcuated; R_{2+3+4} short, less than the basal section of R_5 R_2 pale, R_{3+2} subequal to R_{1+2}; inner ends of cells R_4, R_5, and 1st M_2 in oblique alignment, the last-named most proximad; cell M_1 deep, about one-half longer than its petiole; cell 1st M_2 small, m-cu beyond midlength; anterior arculus present.

Abdomen pale brown, the sternites somewhat paler. Male hypopygium (Plate 2, fig. 34) with the tergite, 9*t*, produced medially into a narrow rod, the apex bilobed. Basistyle, *b*, relatively short and stout, the interbasal process small, pale, appearing as an obtuse blade. Outer dististyle, *od*, a narrow rod, the apex unequally bidentate. Inner dististyle, *id*, very small, pale, setiferous, the lower or cephalic margin before midlength bearing two or three more powerful setæ from tuberculate bases. Ædeagus long and slender, pale, the apex apparently broken in the unique type. Gonapophyses, *g*, appearing as slender hooks, narrowed to the acute tips.

Habitat.—Formosa.

Holotype, male, Rantaizan, altitude 6,000 to 7,000 feet, May 21, 1928 (*S. Issiki*).

The structure of the ninth tergite and outer dististyle somewhat suggests members of the subgenus *Tricholimnophila*, but in other respects there is little in common between the groups.

PILARIA FORMOSICOLA sp. nov.

General coloration shiny dark brown, the pleura more brownish yellow; wings with a strong brown tinge, the stigma darker; R_2 just before the fork of R_{3+4}; cell M_1 present; m-cu at about two-thirds the length of cell 1st M_2; abdominal tergites uniformly blackened, the sternites yellowish brown.

Female.—Length, about 9 millimeters; wing, 8.5.

Rostrum and palpi dark brown. Antennæ (female) relatively elongate, if bent backward extending about to the root of the halteres; antennæ black throughout; flagellar segments elongate, with long conspicuous verticils, the dorsal, unilaterally arranged series much exceeding the segments in length. Head dark brown.

Mesonotum shiny dark brown, the pleura more brownish yellow. Halteres relatively elongate, dusky, especially the knobs. Legs with the coxæ and trochanters yellow; remainder of legs black, the femoral bases vaguely brightened. Wings (Plate 1,

fig. 17) with a strong brownish tinge, the oval stigma darker brown; veins dark brown. Venation: Sc_1 ending some distance before the fork of Rs, Sc_2 at its tip; Rs angulated and weakly spurred at origin; R_2 oblique, just before the fork of R_{3+4}; inner ends of cells R_4, R_5, and 1st M_2 in oblique alignment; cell M_1 longer than its petiole; m-cu at about two-thirds the length of cell 1st M_2; vein 2d A elongate.

Abdominal tergites black, the sternites yellowish brown. Ovipositor with the valves very elongate; tergal valves dark basally, the tips paling to yellow; sternal valves yellow, the bases more narrowly blackened.

Habitat.—Formosa.

Holotype, female, Sorempi, near Giran, altitude 1,500 feet, November 4, 1928 (*S. Issiki*).

ERIOPTERINI

CLADURA DECEM-NOTATA Alexander.

Cladura decem-notata ALEXANDER, Ann. Ent. Soc. America 17 (1924) 436–437.

This interesting species was described from various stations in Kiushiu, Japan. In the present series of Tipulidæ from Professor Issiki were a few males of what appears to be the same species from Shorei, Formosa, altitude 7,000 to 8,000 feet, October 25, 1928. The type series was represented only by females, while the present material includes only males. The Formosan material shows slight differences, chiefly in the size and intensity of the black body markings, and it is possible that they may represent a distinct but closely allied species.

NEOLIMNOPHILA ALTICOLA sp. nov.

General coloration gray; mesonotal præscutum with the cephalic ends of the intermediate and lateral stripes shiny polished black; legs black; wings grayish, the prearcular region yellowish; stigma a little darker than the ground color; male hypopygium with the basistyle having a single curved spinous bristle near base.

Male.—Length, 6.5 to 7 millimeters; wing, 7 to 8.

Female.—Length, 7 to 7.5 millimeters; wing, 7 to 8.

Rostrum dark gray; palpi black. Antennæ black throughout; fusion segment elongate-conical, composed of four subsegments, the sutures between indicated; segments beyond the fusion subcylindrical, gradually increasing in length to the antepenultimate, the remainder shorter. Head brownish gray, the front and restricted posterior orbits clearer gray.

Mesonotal præscutum yellowish gray with four brown stripes, the cephalic end of the intermediate pair and of each lateral stripe polished black; posterior sclerites of mesonotum clearer gray. Pleura gray. Halteres pale, the knobs weakly dusky. Legs with the coxæ gray; trochanters yellowish brown; remainder of legs black, the femoral bases very narrowly and restrictedly obscure yellow. Wings (Plate 1, fig. 18) with a grayish suffusion, the oval stigma only a little darker than the ground color; prearcular region conspicuously yellow; veins brown. Venation: Sc_1 ending about opposite the fork of Rs, Sc_2 at its tip; R_{2+3+4} elongate; R_2 variable in position, in most instances about its own length beyond the fork of R_{2+3+4}; cell 1st M, small; cell M_1 subequal to or slightly longer than its petiole; m-cu variable in position, from close to the fork of M to opposite two-fifths the length of cell 1st M_2.

Abdomen, including the hypopygium, black, sparsely pruinose. Male hypopygium (Plate 2, fig. 35) with the basistyle, *b*, long and slender, at base with a single long curved spinous bristle. Outer dististyle, *od*, long and slender, curved, the apex narrowed and arched, the outer margin with appressed denticles that are somewhat more erect and conspicuous just before the apex. Inner dististyle with conspicuous setæ.

Habitat.—Formosa.

Holotype, male, Shirasetsu, altitude 6,000 feet, October 24, 1928 (*S. Issiki*). Allotype, female, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*). Paratopotypes, 5 males, 1 female; paratypes, 1 male, 1 female, with the allotype.

Neolimnophila alticola is amply distinct from the other species known from eastern and southern Asia; namely, *N. ultima* (Osten Sacken), *N. genitalis* (Brunetti) (equals *simplex* Brunetti), and *N. fuscinervis* Edwards.

LIPSOTHRIX PLUTO sp. nov.

General coloration shiny coal-black; antennæ (male) elongate; legs black, only the extreme bases of the femora obscure yellow; wings with a strong dusky tinge, the oval stigma darker.

Male.—Length, about 7.5 millimeters; wing, 8.5; antennæ, about 3.3.

Rostrum and palpi black. Antennæ (male) elongate, black throughout; flagellar segments cylindrical with verticils that are shorter than the segments; flagellar segments gradually decreasing in length outwardly, the terminal segment abruptly smaller, subglobular. Head dull black.

Thorax shiny coal-black, the anterior lateral pretergites very restrictedly obscure yellow; dorsopleural membrane black. Halteres dirty white, the knobs infumed. Legs with the coxæ and trochanters yellow; femora black, the extreme bases obscure yellow; remainder of legs black. Wings (Plate 1, fig. 19) with a strong dusky tinge, the oval stigma darker brown; veins black, with long conspicuous macrotrichia, especially on the veins beyond origin of Rs. Venation: Sc_1 ending about opposite one-third the length of R_{2+3+4}, Sc_2 at its tip; Rs long, nearly straight; R_{2+3+4} a little shorter than R_{2+3}; R_2 equal to R_{1+2}; m-cu about one-half its length beyond the fork of M.

Abdomen black, the hypopygium a very little paler. Male hypopygium with the basistyles relatively stout, the interbasal process pale yellow, bladelike, narrowed to the acute tip. Outer dististyle entirely blackened, the apical spine much larger than the subterminal appressed tooth. Inner dististyle more elongate, the distal half slender, tufted apically with long stout setæ.

Habitat.—Formosa.

Holotype, male, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

Lipsothrix pluto is a striking species of the genus, very distinct from the only other regional member of the group.

GNOPHOMYIA DEJECTA sp. nov.

General coloration plumbeous black; antennæ relatively elongate, flagellar segments cylindrical; halteres and legs dark brown; wings with a faint brown suffusion, the stigma scarcely darker; Rs in alignment with R_5; cell 1st M_2 relatively elongate, exceeding vein M_4 beyond it; m-cu shortly before midlength of the cell; male hypopygium with the tergite subquadrate, its caudal margin with a U-shaped emargination; outer dististyle a simple glabrous rod.

Male.—Length, about 5.5 millimeters; wing, 6.

Female.—Length, about 6.5 millimeters; wing, 7.

Rostrum and palpi black. Antennæ relatively elongate, black throughout; flagellar segments (male) cylindrical, the outer segments gradually decreasing in length, the terminal segment about two-thirds the penultimate; verticils shorter than the segments. Head brownish black.

Thorax plumbeous black, the posterior sclerites of the pleura somewhat paler; dorsopleural region paler; anterior lateral pretergites restrictedly light yellow. Halteres dark brown, the base of the stem narrowly paler. Legs dark brown. Wings (Plate 1, fig. 20) with a faint brown suffusion, the stigma

scarcely darker; veins dark brown. Macrotrichia of veins of moderate length only. Venation: Sc_1 ending just before R_2, Sc_2 about opposite one-third the length of R_{2+3+4}; Rs in alignment with R_5; r-m at fork of Rs; cell 1st M_2 relatively long exceeding vein M_4 beyond it, m-cu shortly before midlength.

Abdomen dark brown, the hypopygium black. Male hypopygium (Plate 2, fig. 36) small. Ninth tergite 9*t*, small, subquadrate, the caudal margin with a conspicuous U-shaped emargination, the sublateral lobes thus formed acute. Basistyle, *b*, with the mesal margin produced into a short acute black spine. Outer dististyle, *od*, a simple, slender, entirely glabrous rod arising from an expanded base. Inner dististyle shorter, strongly arcuated, the surface with several stout spinous setæ, the apex a little expanded, blackened, glabrous. Ovipositor with the tergal valves relatively short and high, the basal half wider, the distal half slightly upturned, narrowed to the subacute tip.

Habitat.—Formosa.

Holotype, male, Taihoku, April 20, 1922 (*K. Takeuchi*).

Allotype, female, Hokuto, near Taihoku, February 10, 1928 (*S. Issiki*).

Gnophomyia dejecta is allied to *G. orientalis* de Meijere, differing in the larger size and details of coloration.

GNOPHOMYIA BREVICELLULA Alexander.

Gnophomyia brevicellula ALEXANDER, Philip. Journ. Sci. 22 (1923) 472–473.

The type, a unique male, was taken at Tattaka, Formosa, altitude 7,400 feet, August 16, 1921, by Teiso Esaki. A second male specimen is now on hand, collected at Chikurin, Formosa, altitude 3,000 feet, July 3, 1928, by Syuti Issiki.

The wing venation has not been figured and is shown herewith (Plate 1, fig. 21). The male hypopygium exhibits a rather remarkable structure of what seems to be ninth tergite (Plate 2, fig. 37). This supposed tergite, 9*t*, appears as a somewhat lyriform structure, the long divergent arms being gradually widened to shortly before the tips, thence narrowed to the acute points. In the holotype, as figured, the arms are slightly shorter and broader than in the more recently discovered specimen. Outer dististyle, *od*, a long slender arm, the tip obtusely rounded. Inner dististyle, *id*, expanded at base, the curved apical portion with flattened peglike setæ.

TRENTEPOHLIA (MONGOMA) ATAYAL sp. nov.

Size small (wing, male, 5 millimeters); antennal verticils short; mesonotum dark brown, the præscutum brownish yellow with a conspicuous dark brown median stripe; legs pale; wings with a grayish tinge, almost unmarked except for the stigma and an apical clouding; apical fusion of Cu_1 and 1st A slight.

Male.—Length, about 5 millimeters; wing, 5.

Rostrum and palpi dark. Antennæ brown throughout, of moderate length; flagellar segments cylindrical, with short verticils. Head blackish gray, carinate medially.

Mesonotal præscutum brownish yellow, with a conspicuous dark brown median stripe that is slightly wider behind; scutum similarly pale, the centers of the lobes extensively dark brown; scutellum and postnotum dark brown. Pleura uniformly dark brown. Halteres short, dark brown, the base of the stem restrictedly pale. Legs with the fore coxæ darkened, the remaining coxæ paler; trochanters yellow; remainder of legs pale brownish yellow, without clearly defined pattern, the tarsi passing into darker; no especial armature on legs other than two elongate setæ at tips of femora. Wings (Plate 1, fig. 22) with a grayish tinge, the prearcular region and cells C and Sc more yellowish; stigma elongate-oval, brown; wing apex narrowly and diffusely darkened; restricted brown seams along vein Cu and in cell 1st A at angulation of vein 2d A; veins brown. Venation: Rs subequal to R_{2+3+4}; cell R_3 large; inner end of cell M_3 lying proximad of other cells beyond cell 1st M_2; m-cu at fork of M; fusion of Cu_1 and 1st A slight, about one-half m-cu; vein 2d A subangulate before midlength.

Abdomen brownish black, including the hypopygium, the central portions of the intermediate tergites paler.

Habitat.—Formosa.

Holotype, male, Inzan, near Giran, November 2, 1928 (*S. Issiki*).

Trentepohlia (*M.*) *atayal* is distinguished from allied small species of the subgenus by the combination of characters, as diagnosed above.

TRENTEPOHLIA (MONGOMA) TARSALBA sp. nov.

General coloration dark brown, the posterior sclerites of the mesonotum and the pleura paler; legs black, the tarsi chiefly snowy white; wings grayish, variegated with brown seams, including vein Cu and the fused portion of Cu_1 and 1st A; veins Cu_1 and 1st A extensively fused before margin.

Female.—Length, about 5.5 millimeters; wing, 5.2.

Rostrum and palpi dark, the tips of the labial palpi yellow. Antennæ black throughout. Head black.

Mesonotum dark brown, the lateral margins of the præscutum and posterior sclerites of the notum more testaceous. Pleura testaceous, the dorsal pleurites darker. Halteres short, dusky. Legs with the coxæ and trochanters concolorous with the pleura, the fore coxæ somewhat darker; femora and tibiæ black; basitarsi brown, paling to white at tips; remainder of tarsi snowy white, the terminal segment darkened. Wings (Plate 1, fig. 23) grayish, sparsely variegated with brown, including the elongate stigma; a longitudinal brown wash on vein Cu in cell M, beyond the fork of the vein continued along the fused Cu_1 + 1st A to the wing margin; axillary region somewhat darkened; wing apex a little suffused; veins brown. Venation: Rs longer than the basal section of R_5; R_{2+3+4} very long, exceeding R_4; R_2 longer than R_{3+4}; vein R_5 powerful, the medial veins beyond the fork of M weak and semievanescent; inner end of cell M_3 lying proximad of the others; fusion of Cu_1 and 1st A extensive, more than twice m-cu.

Abdomen black, the sternites somewhat paler. Ovipositor with relatively large and conspicuous valves, the tergal valves dark, strongly upcurved, the sternal valves high, yellow, dark at base.

Habitat.—Formosa.

Holotype, female, Giran, November 5, 1928 (*S. Issiki*).

The only described species of the subgenus *Mongoma* with a similar venation of the cubital and anal fields is *T.* (*M.*) *retracta* Edwards.

ORMOSIA SHOREANA sp. nov.

Size relatively large (wing, male, 6 millimeters); general coloration gray, the præscutum with a brown median stripe; femora obscure yellow with a broad brownish black subterminal ring; wings dusky, variegated with darker brown and pale areas; cell M_2 open by the atrophy of the basal section of M_3; vein 2d A strongly sinuous; male hypopygium with the dististyles subterminal in position, three in number, all simple.

Male.—Length, about 5 millimeters; wing, 6.

Rostrum and palpi brownish black. Antennæ of moderate length; basal segments pale brown; flagellum black, the incisures restrictedly pale; flagellar segments gradually decreasing in size outwardly, with long, unilaterally arranged verticils. Head dark gray.

Pronotum brownish gray, the lateral pretergites yellow. Mesonotal præscutum brownish gray, with a brown median stripe and less evident lateral stripes; scutum gray, the centers of the lobes variegated with darker; scutellum and postnotum heavily pruinose. Pleura gray. Halteres with the basal half of the stem yellow, the distal half infuscated, the knobs paling to obscure yellow. Legs with the coxæ gray; trochanters obscure yellow; femora obscure yellow, with a broad brownish black subterminal ring, the tips narrowly yellow; tibiæ black, the extreme bases pale; tarsi black. Wings (Plate 1, fig. 24) with a strong dusky suffusion, the costal and stigmal regions darker brown; extensive paler areas, as follows: Before and beyond the origin of Rs, the latter extending cephalad into cell Sc_1; outer end of cell R and across the fork of M into the adjoining cells; axillary region pale; veins brown. Venation: Sc_1 ending just beyond R_2, Sc_2 opposite one-fifth the length of Rs; R_2 a trifle longer than R_{2+3}; cell M_2 open by the atrophy of the basal section of M_3; m-cu a little less than its own length before the fork of M; vein 2d A very strongly sinuous.

Abdomen, including the hypopygium, black, more or less pruinose. Male hypopygium (Plate 2, fig. 38) with the ninth tergite, 9*t*, apparently double as in this group of species, there being a paler and more fleshy structure beneath the true tergite, the latter profoundly bifid. Basistyle, *b*, produced slightly beyond the level of insertion of the dististyles. Dististyles, *d*, three, the outermost a glabrous earlike portion; longest style gently curved to the obtuse apex, the ventral margin with pale membrane set with tubercles; innermost style a slender curved rod, the tip acute or nearly so.

Habitat.—Formosa.

Holotype, male, Shōrei, altitude 7,000 to 8,000 feet, October 25, 1928 (*S. Issiki*).

All of the Formosan species of *Ormosia* known to me have this apparent duplication of the ninth tergite, there being a paler and thicker flattened structure immediately beneath the outer tergal plate.

ILLUSTRATIONS

[Legend; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *i*, interbasal process; *id*, inner dististyle; *od*, outer dististyle; *t*, ninth tergite; *vd*, ventral dististyle.]

Plate 1

Fig. 1. *Nesopeza basistylata* sp. nov., venation.
2. *Stibadocerella formosensis* sp. nov., venation.
3. *Stibadocerella pristina* Brunetti, venation.
4. *Cyttaromyia taiwania* sp. nov., venation.
5. *Limonia* (*Libnotes*) *clitelligera* sp. nov., venation.
6. *Limonia* (*Limonia*) *tenuicula* sp. nov., venation.
7. *Limonia* (*Dicranomyia*) *aurita* sp. nov., venation.
8. *Limonia* (*Dicranomyia*) *montium* sp. nov., venation.
9. *Limonia* (*Alexandriaria*) *atayal* sp. nov., venation.
10. *Orimarga fuscivenosa* sp. nov., venation.
11. *Thaumastoptera* (*Taiwanita*) *issikiana* sp. nov., venation.
12. *Helius* (*Helius*) *liliputanus* sp. nov., venation.
13. *Ula fuscistigma* sp. nov., venation.
14. *Pseudolimnophila autumnalis* sp. nov., venation.
15. *Troglophila ritozanensis* sp. nov., venation.
16. *Limnophila rantaizana* sp. nov., venation
17. *Pilaria formosicola* sp. nov., venation.
18. *Neolimnophila alticola* sp. nov., venation.
19. *Lipsothrix pluto* sp. nov., venation.
20. *Gnophomyia dejecta* sp. nov., venation.
21. *Gnophomyia brevicellula* Alexander, venation.
22. *Trentepohlia* (*Mongoma*) *atayal* sp. nov., venation.
23. *Trentepohlia* (*Mongoma*) *tarsalba* sp. nov., venation.
24. *Ormosia shōreana* sp. nov., venation.

Plate 2

Fig. 25. *Nesopeza basistylata* sp. nov., male hypopygium.
26. *Limonia* (*Limonia*) *tenuicula* sp. nov., male hypopygium.
27. *Limonia* (*Dicranomyia*) *aurita* sp. nov., male hypopygium.
28. *Limonia* (*Dicranomyia*) *montium* sp. nov., male hypopygium.
29. *Thaumastoptera* (*Taiwanita*) *issikiana* sp. nov., male hypopygium.
30. *Helius* (*Helius*) *nawaianus* sp. nov., male hypopygium, dististyle.
31. *Helius* (*Helius*) *nipponensis* Alexander, male hypopygium, dististyle.
32. *Helius* (*Helius*) *liliputanus* sp. nov., male hypopygium.
33. *Pseudolimnophila autumnalis* sp. nov., male hypopygium.
34. *Limnophila rantaizana* sp. nov., male hypopygium.
35. *Neolimnophila alticola* sp. nov., male hypopygium.
36. *Gnophomyia dejecta* sp. nov., male hypopygium.
37. *Gnophomyia brevicellula* Alexander, male hypopygium.
38. *Ormosia shōreana* sp. nov., male hypopygium.

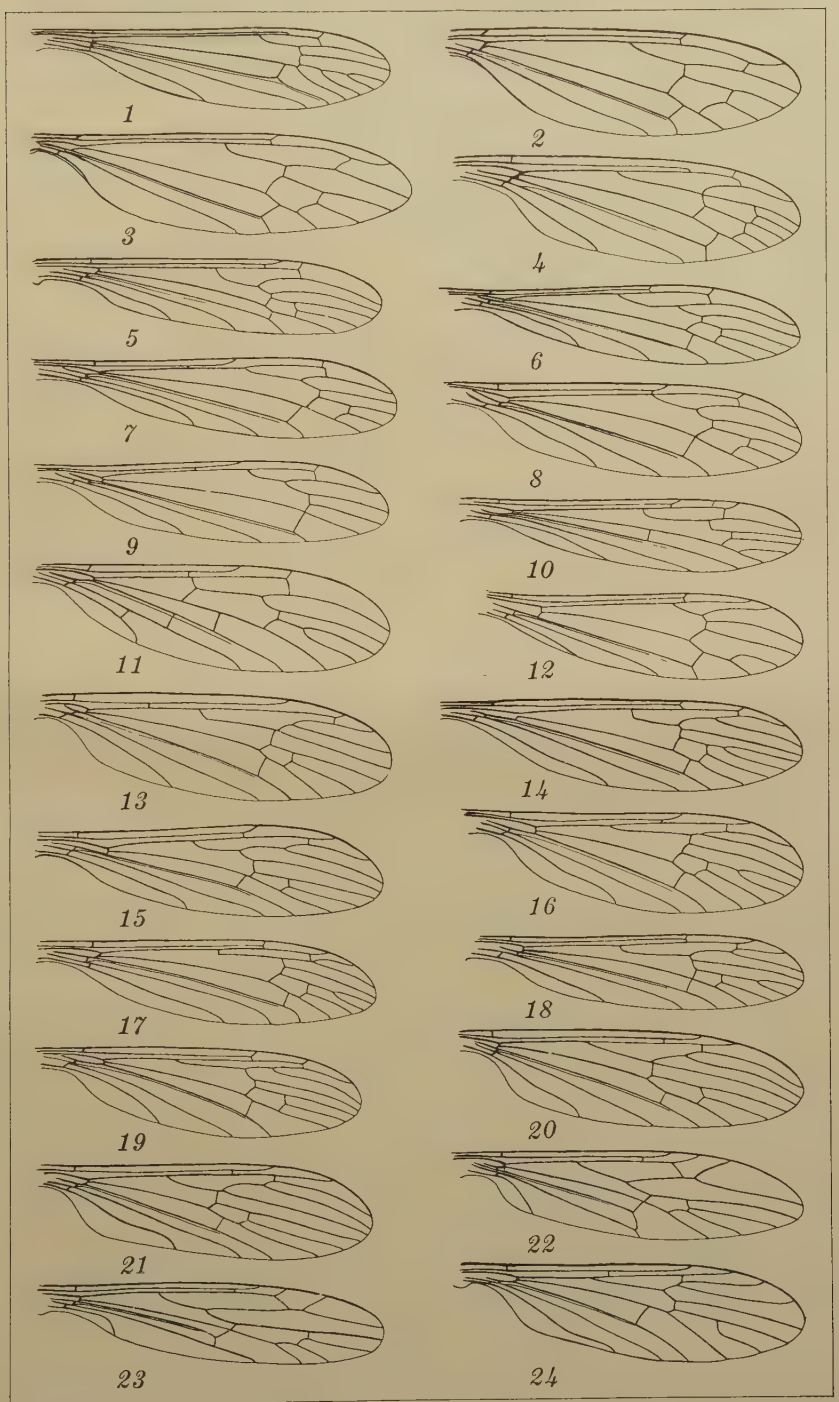

PLATE 1.

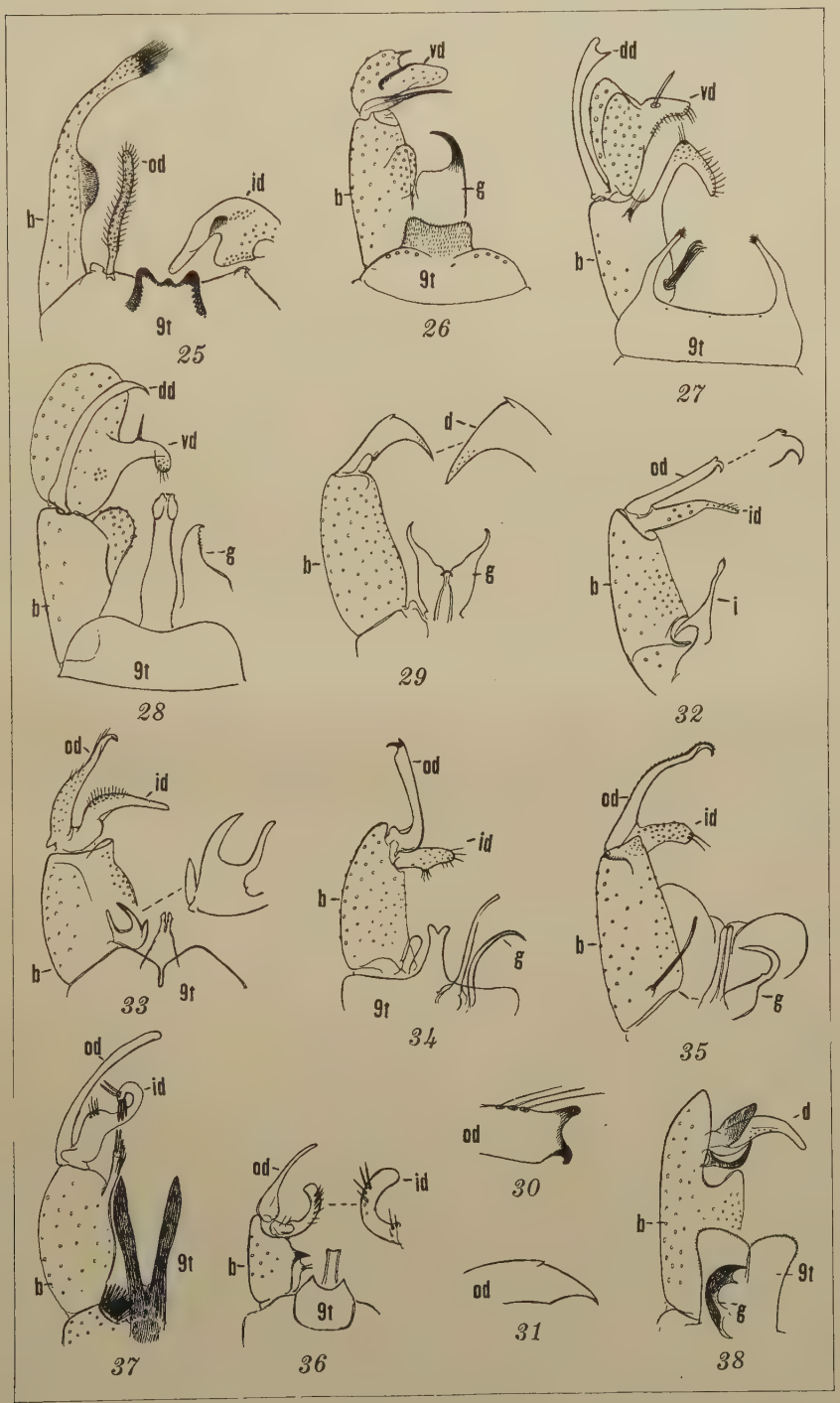

PLATE 2.

ERRATA

The following tables are to be substituted for the corresponding tables on pages 77, 86, 84, 85, and 87, respectively.

TABLE 1.—*Showing the serologic results after subcutaneous, intraperitoneal, and intramuscular vaccination against yaws.*

[+, 25 per cent inhibition of hæmolysis; ±, less than 25 per cent inhibition of hæmolysis; —, complete hæmolysis; 0, not done.]

Designation of monkey.	Date and modus of vaccination.			Wassermann reaction. Results and dates.				Revaccination, VIII–4–28.	Wassermann reaction after revaccination.	
	First, VI–14–28.	Second, VI–22–28.	Third, VI–30–28.	Before vaccination, VI–13–28.	After vaccination.				VIII–16–28.	VIII–30–28.
					VII–13–28.	VII–27–28.	VIII–2–28.			
c–1	Intrap	Intrap	Intrap	—	—	—	—	Intrap	—	—
c–2	do	do	do	—	—	—	—	do	—	—
d–1	Intram	Intram	Intram	—	—	—	—	Intram	—	—
d–2	do	do	do	—	—	—	—	do	—	—
d–3	0	Subcut	Subcut	—	—	±	+	Subcut	±	+
d–4	0	do	do	—	—	±	—	do	±	—

TABLE 2.—*Showing the serologic results after subcutaneous, intraperitoneal, and intramuscular vaccination against yaws. Both Wassermann and Kahn reactions considered.*

Designation of monkey.	Date and modus of vaccination.			Wassermann reaction. Results and dates.				Revaccination, VIII–4–28.	Wassermann and Kahn reaction after revaccination.	
	First, VI–14–28.	Second, VI–22–28.	Third, VI–30–28.	Before vaccination, VI–13–28.	After vaccination.				VIII–16–28.	VIII–30–28.
					VII–13–28.	VII–27–28.	VIII–2–28.			
c–1	Intrap.	Intrap.	Intrap.	— —	— —	— —	— —	Intrap.	— —	— —
c–2	do	do	do	— —	— —	— —	— —	do	— —	— —
d–1	Intram.	Intram.	Intram.	— —	— —	— —	— —	Intram.	— —	— —
d–2	do	do	do	— —	— —	— —	— —	do	— —	— —
d–3	0	Subcut.	Subcut.	— ±	— ++	± ++	+ ++++	Subcut.	± ++++	+ +++
d–4	0	do	do	— ±?	— —	± —	— —	do	— —	— —

The marks above are for Wassermann reaction. The marks below are for Kahn test.

TABLE 1.—*Showing the results of Wassermann and Kahn tests performed on yaws-vaccinated monkeys.*

[—, complete hæmolysis; ±, less than 25 per cent inhibition; +, 25 per cent inhibition; ++, 50 per cent inhibition; +++, 75 per cent inhibition; ++++, 100 per cent inhibition; 0, not done; l, lens. For interpretation of Kahn test see text.]

Designation of monkey.	Vaccination.						Vaccine killed 1 hour at—	After vaccination.			
	Number.	Date.	Number.	Date.	Number.	Date.		Wassermann reaction before vaccination.	Date.	Result of— Wassermann reaction.	Result of— Kahn test.
W-57	1	III- 5-28	2	III-12-28	3	III-20-28	80° C.	—	IV- 7-28	+++	0
									V- 3-28	++	+ l
									V-28-28	—	—
W-58	1	III- 5-28	2	III-12-28	3	III-20-28	80° C.	—	IV- 7-28	+++	0
									V- 3-28	+	± l
									V-28-28	—	—
W-59	1	III- 5-28	2	III-12-28	0	----------	80° C.	—	IV- 7-28	++	0
									V- 3-28	+	+ l
									V-28-28	±	—
									VI-21-28	±	—
									VII- 6-28	—	—
									VII-18-28	—	—
W-60	1	III- 5-28	0	III-12-28	0	----------	80° C.	=	IV- 7-28	+	0
									V- 3-28	±	± l
									V-28-28	±	—
W-61	1	III- 5-28	0	----------	0	----------	80° C.	—	IV- 4-28	—	0
									V- 3-28	+	—
									V-28-28	+	—
									VII- 6-28	—	—
									VII-18-28	—	—
									VII-30-28	—	—

W-63	1	III- 5-28	2	III-14-28	3	III-20-28	[a] 80° C.	—	IV- 7-28	—	0
									V- 3-28	±	± 1
									V-28-28	—	—
									VII-18-28	—	—
									IX-18-28	—	—
W-64	1	III- 5-28	2	III-14-28	3	III-20-28	[a] 80° C.	=	IV- 7-28	±	0
									V- 3-28	+	—
									V-28-28	—	—
									VII-18-28	—	—
									IX-18-28	—	—
K-9	1	IV-11-28	1	IV-16-28	1	IV-27-28	100° C.	—	V-17-28	+	±
A-8	1	IV-11-28	1	IV-16-28	1	IV-27-28	100° C.	—	V-17-28	+	± 1
J-18	1	IV-16-28	1	IV-27-28	0		100° C.	—	V-17-28	+ + + +	+ + +

[a] Diluted.

TABLE 3.—*Showing the result of Wassermann reaction and of Kahn test in monkeys immunized with normal and inflammatory tissues from normal skin of normal and yaws monkeys.*

[—, complete hæmolysis; ±, less than 25 per cent inhibition; +, 25 per cent inhibition; ++, 50 per cent inhibition; +++, 75 per cent inhibition; ++++, 100 per cent inhibition; 0, not done. For interpretation of Kahn test see text.]

Designation of monkey.	Material used for subcutaneous vaccination.	Date and result of Wassermann and Kahn reactions after immunization.		Date and result of inoculation with yaws.	Date and result of Wassermann and Kahn reactions after infection and superinfection with yaws treponemas.							
R-3	Normal skin from normal monkey.	VI-20-28	VII-5-28	VII-19-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-23-28	X-31-28		
		[a]—	—	yaw	—	—	—	Dead	Dead	Dead	0	
		±1	—		±	+	++					
R-4	do	VI-20-28	VII-5-28	VII-19-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-23-28	X-31-28		
		—	—	yaw	—	—	—	—	+	—	0	
		—	—		±1	±	+	—	+	+		
S-4	Normal skin tissue from yaws monkey.	VI-20-28	VII-5-28	VIII-2-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-23-28	X-31-28		
		—	—	yaw	—	—	—	—	±	—	0	
		—	—		—	—	—	—	+	—		
A-1	Inflammatory skin tissues from normal monkey.	VII-2-28	VII-16-28	VII-31-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-23-28	X-31-28		
		—	—	yaw	—	++	—	—	+	±	0	
		—	—		—	—	—	—	—	—		
A-2	do	VII-2-28	VII-16-28	VII-31-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-23-28	X-31-28		
		—	—	yaw	—	+++	+	+++	++	±	0	
		+	++		++++	++++	++++	++++	+	+		
Z-1	Inflammatory skin tissues from yaws monkey.	VI-20-28	VII-5-28	VIII-2-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-10-28	X-31-28	XI-14-28	XI-7-28
		—	—	yaw	—	—	—	—	—	—	±	—
		—	—		—	—	—	—	—	—	—	+
Z-2	do	VI-20-28	VII-5-28	VIII-2-28	IX-3-28	IX-13-28	IX-27-28	X-10-28	X-10-28	X-31-28	XI-14-28	XII-7-28
		—	—	yaw	—	—	—	—	—	—	±	—
		±1?	—		—	—	—	—	—	—	—	—

[a] The marks above are for Wassermann reaction. The marks below are for Kahn test.

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[New names and new combinations are printed in **boldface.**]

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